JOURNAL OF FORENSIC SCIENCES

Official Publication of the American Academy of Forensic Sciences

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JOURNAL OF FORENSIC SCIENCES

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SAMUEL A. LEVINSON, M.D., Ph.D., *Editor*
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The Journal of Forensic Sciences is the official publication of the American Academy of Forensic Sciences. It is devoted to the publication of original investigations and observations in the various branches of the forensic sciences; these include forensic pathology, toxicology, psychiatry, immunology, jurisprudence, criminalistics and questioned documents. The journal will be published quarterly, one volume of four issues appearing each year.

Message from the President

Although a considerable number of forensic science books have been published in this country, there has been a great need for a journal devoted exclusively to the forensic sciences. Many important case studies, and much valuable research have not come to the attention of fellow scientists because of the lack of a suitable journal for the publication of such information. What has been published has been widely scattered in journals of one type or another, some of which have been very obscure or inappropriate for the particular subject matter. Moreover, the absence of an appropriate journal for the publication of the results of case studies and research has accounted, in good measure, for the fact that many forensic scientists have neglected to prepare for publication articles which would have been very helpful to their colleagues.

All of these factors have been keenly appreciated by the founders, officers, and members of the American Academy of Forensic Sciences. From the very inception of the Academy there has been talk of a journal; and in more recent periods the possibilities of a forensic science journal were very seriously explored. As a result of this continuing interest and effort, a plan and arrangement finally evolved for the present publication—The Journal of Forensic Sciences. Although it will serve as the official publication of the Academy, it is available to all other interested persons, both for reading and for the publication of significant case studies and research.

The Journal will render unnecessary a separate publication devoted to the proceedings of the annual meetings of the Academy. A much less costly and more appropriate medium is now available to us, not only for the publication of papers presented at the meetings but also for other case studies and research. The Journal will also give to the Academy a professional status not otherwise attainable, and this factor will be of particular importance to members when testifying in court.

JOURNAL OF FORENSIC SCIENCES

With the unanimous approval of the Executive Committee, the President requested Dr. Samuel A. Levinson to serve as the Editor for the first volume of the Journal. He accepted this responsibility and with the assistance of Dr. Walter Camp and Dr. Camp's Secretary, Miss Polly Cline, the first number of the Journal for the most part was prepared from papers presented at the last two meetings of the Academy. For the remaining three numbers of the first volume, Dr. Levinson will have the assistance of seven "Editorial Consultants"—one from each section of the Academy: Dr. Russell S. Fisher (Pathology); Dr. Robert B. Forney (Toxicology); George E. Hall (Jurisprudence); Clemens R. Maise (Criminalistics); Clark Sellers (Questioned Documents); Dr. Maier I. Tuchler (Psychiatry); and Dr. Alexander S. Wiener (Immunology).

Although it has been my good fortune to be serving as President of the Academy at a time when the Journal makes its first appearance, what made that event possible was the vision, encouragement, and inspiring efforts of the many officers and members who have served the Academy so well in the past. That same interest and cooperation will insure the future success of The Journal of Forensic Sciences.

FRED E. INBAU

Message from the Publisher

The publication of this first issue of the Journal of Forensic Sciences represents the culmination of many months of planning with Professor Fred E. Inbau, President, Dr. Walter Camp, Secretary-Treasurer of the American Academy of Forensic Sciences, Dr. Samuel A. Levinson, Editor in Chief and his editorial consultants. All that the Journal represents can be attributed to them.

Both the publisher and the Academy hope that this publication will provide help and guidance for many segments of our society. At first impression, it might appear that the subject matter is of very limited appeal; however, such is not the case. Articles appearing in this publication will naturally be of interest to members of the American Academy of Forensic Sciences who are themselves specialists in the fields being covered, but more important, the materials will contribute in many ways in helping the leaders of our community better understand the problems with which individuals are constantly faced. Doctors, judges, lawyers, ministers, psychiatrists, criminologists, police officers and others charged with a role of civic trust will find much within the pages of this Journal that will aid them in the more efficient performance of their duties.

It is with this conviction that we have embarked on this venture with complete confidence in the ability of the Academy to provide materials that will be both thought-provoking and of interest to the many facets of our society that we hope will soon be using the Journal.

CALLAGHAN & COMPANY

EDITORIAL

"Forensic" Sciences

George E. Hall, J.D.

The term "forensic" is from the Latin words "forensis" and "forum" meaning "market place, forum." Forensic, used as an adjective, means "pertaining to courts of justice or to public disputation"; "relating to or used in judicial proceedings"; "belonging to public debate or discussion"; "argumentative." It is in the sense of relationship to judicial proceedings or, even more broadly, to the administration of justice, that the term is most commonly used today and it is in that sense that the term is used in the name of this new journal and the organization which it represents—The American Academy of Forensic Sciences. Sometimes the term forensic medicine is used. Strictly speaking the two terms are not synonymous because medicine is just one of the many sciences which serve society by furnishing the facts which are used in judicial proceedings. Actually that part of the knowledge possessed by any science which is utilized in the administration of justice in any way, either in criminal or civil matters, may be referred to as forensic in character.

Those sciences which have, to date at least, contributed the most, and it has indeed been much, toward the presentation of proof in our courts of justice are represented by the seven scientific sections of the Academy. As most of the readers of this Journal know, six of these sections are: (1) pathology, with its evidence of the cause and manner of death, the identification of human remains, the relationship between trauma and all kinds of injuries and disease; (2) toxicology, with its knowledge of poisons in relation to crime and occupational disease, and its development of chemical tests for the determination of alcoholic intoxication; (3) psychiatry, with its

assistance in the rehabilitation of the maladjusted, its evidence in cases of insanity, its ability as a counselor in many sociological, legal and medical situations; (4) immunology, with its remarkable discoveries concerning the use of blood as a means of identification and as a protection to men falsely accused of fathering illegitimate children; (5) questioned documents, with its growing ability to reveal forgeries of all kinds; (6) criminalistics, scientific crime detection, with its insistence upon adequate police laboratories and its use of fingerprinting, ballistics, tire impressions, physical measurements, photography (including ultra violet and X-ray), microscopy, spectrophotometric analysis—the list is almost endless. The seventh scientific section is jurisprudence. At first blush it may seem that the term forensic jurisprudence is almost like saying legal law. Remember, however, that forensic means relating to the administration of justice. All of law does not involve the presentation of proof in judicial proceedings but some of it does. Forensic jurisprudence, therefore, is that part of jurisprudence which has developed, and is continuing to develop, the best methods and techniques for utilizing the knowledge furnished by the other sciences. It is the catalyst through which facts pass from the laboratory to the courtroom.

These, then, are the forensic sciences. These are the disciplines upon which society must rely if truth is to prevail in the adjudication of individual and community rights. These are the *raison d'etre* of the American Academy of Forensic Sciences, to the advancement of which this Journal is dedicated.

The Historical Development of Toxicology

With Interesting Cases from the Files of the Chief Medical Examiner's Office of New York City *

Alexander O. Gettler, Ph.D., New York City

It seems probable that poisonous plants must have been recognized by prehistoric man. Ancient writings indicate a knowledge of some poisons in the early civilizations of Egypt and India. The interpretation of a passage in an extremely ancient papyrus in the Louvre is: "Speak not of the name of Yao under penalty of the peach," the inference being that the Egyptian priests were acquainted with hydrocyanic acid from peach leaves or kernels. The papyrus Ebers also mentions lead, antimony, copper, opium and hyoscyamus. As early as 900 B. C., the Hindus possessed knowledge of a few poisons, their symptoms and antidotes. They were also aware of the intoxicating effects of alcohol. In 600 B. C. we find references to antidotes in the Odyssey and in the Shastras.

The early Greeks were acquainted with some poisons and venoms. Ulysses and Hercules annointed their arrows with poisons or venom of serpents. In 339 B. C., Socrates was executed by poisoning with extract of hemlock; in 333 B. C. an attempt was made on the life of Alexander the Great by his physician; in 331 B. C. there were mass poisonings in Rome. Theophrastus' "History of Plants" in 300 B. C. refers to the poisonous as well as medicinal action of vegetable poisons. In the period 14 A. D.—60 A. D. there were the poisoners of note: Livia, the wife of Augustus; Martina, and Agrippina. Up to about 1500, symptomatic toxicology made but little

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advance while there were innumerable poisonings. Nine of the successors of Charlemagne (Roman Empire) before 1438 died from poison. Five Popes (Rome) before 1471 died of poison; Pope Alexander VI and Caesar Borgia 1492–1503 poisoned many, including Cardinals. Pope Alexander was finally himself poisoned. Many kings and their mistresses were poisoned.

With the Renaissance in Italy, poisoning became an art. Kings and princes were protected by picked guards. They partook of the food and wine before serving to the king. In 1414 Ladislas, King of Naples, died from poison, which a physician placed on the lips of his daughter, the King's mistress.

During the 16th and 17th centuries, poisoning was rampant in France, Italy and England. Some of the most noted poisoners were Catharine di Medicis, Marchioness of Brinvilliers, Exili, Sante Croix, La Voisin and La Vigoureux and Doctor Castaing. Henry III ordered any poisoner to be boiled to death. In 1659, Spara headed a secret poisoning society in Rome, and in 1709 Madam Toffana engaged in poison traffic at Naples. She poisoned about 600 persons with white arsenic. Between 1803 and 1831 in Germany, Frau Geheimrathin Anna Zwanziger and Margarethe Gottfried were the most conspicuous poisoners. The poisons used were mainly hemlock, aconite, opium, arsenic and corrosive sublimate.

Persons were convicted on circumstantial evidence such as malicious intent and sudden onset of symptoms. Neither autopsies nor chemical analyses of the organs were performed until Plenck in 1781 published the statement "The only certain sign of poisoning is the chemical identification of the poison in the organs of the body." In 1821, Orfila proposed a division of poisons into four classes: Irritants, narcotics, narcotico-acrids and putrefiants.

The following five events marked the beginning of important stages in the development of chemical toxicology:

1. James M. Marsh in 1836 devised his test for arsenic, based upon Scheele's discovery in 1775 that when zinc and acid act on arsenic, a gaseous compound is evolved which, on burning, deposited metallic arsenic. Serullas in 1821, however, had already utilized the decomposition of arsine for the detection of small quantities of arsenic in stomach contents and urine of poisoning cases.

2. Orfila (1839) was the first one to extract arsenic from human organs. Previously only the gastro-intestinal contents were used for analysis.
3. Fresenius and von Babo (1844) devised a scheme for the systematic search for all mineral poisons. They used wet ashing with chlorine.
4. Stas-Otto (1850) devised a method for the extraction of alkaloids from cadavers. This method with modifications is still in use.
5. Selmi (1874) showed that a substance isolated from the organs of a body that had been buried two weeks, and reported to be morphine, was in reality a morphine-like ptomaine or cadaveric alkaloid. Many other alkaloid-like ptomaines have since been reported.

A book entitled "Poisons and Asphyxia," by Henry Coley, published in New York City in 1832, discusses the preparation, chemical composition, solubility, taste, medical use, dosage, symptoms of poisoning, cause of death, post-mortem appearance and remedies for mineral acids, caustic alkalies, ammonia, nitrates, phosphorus, cyanide, the poisonous metals and several alkaloids.

For analysis, only gastric contents were used, never the internal organs. The qualitative tests available were very crude; for instance: Nitric acid in stomach—introduce a strip of copper and yellow fumes develop; bichloride of mercury—separate the insoluble powder in stomach, dry, place in tube, add powdered charcoal and heat, the mercury will volatilize on upper cool part of tube; if no solid powder in stomach, introduce a gold ring, it will become silvery coated; for copper—add ammonia to stomach contents and observe blue color. There are no reported qualitative tests for any of the alkaloids except opium, where he adds ammonia and this precipitates the morphine; the precipitated morphine is dried and treated with nitric acid, producing a red color. There are no quantitative determinations cited in the entire book.

In Casper's Vierteljahrschrift für Gerichtliche Medizin, Berlin, Volume for 1852 and 1853, the only articles on chemical toxicology are: Qualitative test for copper in urine, qualitative test for phosphorus in gastric contents, arsenic in organs by Marsh test, qualitative test for oxalic acid in gastric contents, qualitative tests for nicotine. Notice the absence of quantitative determinations.

The qualitative analysis for metals in organs began with the Marsh test for arsenic in 1836 and the Reinsch test for arsenic and mercury in 1841. Then followed tests for other metal poisons. In order to apply the tests, the organs had to be ashed. Wet ashing was first devised by Duflos in 1838 and by Fresenius and Babo in 1844. The qualitative tests that were used were those found in the inorganic qualitative textbooks of the time.

The qualitative tests for carbon monoxide (Hoppe Seyler's, Spectroscopic, Salkowski's alkali, Stopczanski's dilution and tannic acid precipitation) in the blood were developed between 1865 and 1889; the Lieben's iodoform test for alcohol in 1870; Hofmann's isonitrile reaction for chloroform in 1868 and Schwartz' Resorcin reaction for chloroform in 1888. A few crystalline derivatives of alkaloids were first prepared between 1846 and 1884, and some color reactions for alkaloids between 1861 and 1883.

Micro sublimation was first demonstrated by Helwig in 1865. The quantitative determination of metals in organs began about 1850. The usual methods were to weigh the metal as the sulfate or the oxide. It was in 1862 that electrolytic deposition was first used. The quantity was determined by the increase in weight of the electrode. Titrimetric methods for As, Sb, Hg, Pb came much later. For carbon monoxide in blood, Fodor in 1880 aerated the carbon monoxide into a solution of palladium chloride. The precipitated palladium was washed and dissolved in aqua regia. The solution evaporated to dryness, the residue dissolved and titrated with a standard KI solution. In 1867 Schmiedeberg decomposed chloroform in a combustion tube containing magnesium oxide and then titrated the chloride.

Quantitative methods for alcohol based upon the reduction of chromic acid were devised between 1852 and 1883 by Cotte, Subbotin, Bodländer, and Strassmann. A micromethod was published by Nicloux in 1906, and by Widmark in 1922. Many excellent quantitatve methods for alcohol in blood, urine, spinal fluid, expired air and tissues have been developed during our time by Doctor E. Bogen, J. W. Cavett, W. W. Jetter, A. O. Gettler, L. A. Greenberg, H. W. Haggard, R. N. Harger, H. A. Heise, L. D. MacLeod, C. W. Muehlberger, T. Winnick and others.

Quantitative methods for alkaloids came into use about 1890. The alkaloid was extracted, purified, dried and weighed; or the chloroform solution of the alkaloid was extracted with a definite quantity of N/100 HCl and the excess HCl titrated with N/100 alkali; or the slightly acidified aqueous solution was titrated with a solution of potassium mercuric iodide, Mayers Reagent.

Toxicological analyses of the organs of human bodies up to 1900 were few and far between. The main reason for this defect was that coroners decided on the cause of sudden and violent deaths. Most of our coroners were laymen. In New York City from 1898 to 1915, we had as coroners 8 undertakers, 7 politicians, 6 real estate dealers, 2 saloon keepers, 2 plumbers, 1 lawyer, 1 printer, 1 auctioneer, 1 contractor, 1 wood carver, 1 carpenter, 1 painter, 1 butcher, 1 expressman, 1 marble cutter, 1 labor leader, 1 insurance agent, 1 milkman, 1 musician, 1 dentist, and 19 physicians. The latter were not medico-legal pathologists nor toxicologists, but as stated by the National Research Council bulletin, "not one of these physicians could present evidence of good reputation in the medical profession of the city." The coroners in all of the other states, on the average, were no different. It never even occurred to them to have the organs chemically analyzed. County physicians also had no available toxicological laboratories. It may be interesting to note that a Medical Examiner's office was instituted in Boston, Mass., as early as 1878. Yet, in 1933, during the Jessie Costello trial, I was surprised to learn that they had no toxicological laboratory functioning. It was only after this trial that they provided a laboratory for routine toxicological analysis. The medical examiner's system in Connecticut has only provided a toxicological laboratory at Hartford about three years ago. From what I am able to learn, even the medico-legal institutes in Europe do very little routine toxicology.

Occasionally, when a case received notoriety, then the coroner sought the services of some one, usually a professor of chemistry. In New York City during the 1890's, we had Professors Doremus, Witthaus and Mandel. They had but little experience in toxicological analyses of human organs. It took one of these professors 20 months, from April 30, 1894 to December 1895 to analyze the organs of one body. During

this time, he went on a three-month European vacation in the summers of 1894 and 1895.

I have outlined the toxicological status when I started in this field in 1910. In 1918, the Chief Medical Examiner's Office of New York City was instituted. A toxicological laboratory was set up at once. As time went on, we added more and more equipment, and today, we have such instruments as a Spectrograph, an infra-red recording Spectrophotometer, a Beckman Spectrophotometer with ultra-violet attachment, a Bausch & Lomb Densitometer with a Brown Recorder, and many others.

The development of toxicological methods since 1918 is familiar to those active in the Forensic Sciences. I will only mention a few additional substances toxicologists have had to deal with since 1910: Antabuse, ANTU, antihistamines, barbiturates, D.D.T., chlorinated hydrocarbons, Demerol, Dolophine, Dromoran, Dilaudid, Dormin, Dormison, Dilantin, mescalene, Phenurone, Pontocaine, Phenyl Butazone, Procaine, sulfa drugs, Tolserol, Tromexan, and many other substances. Among the newly developed methods, I will only mention the quantitative microcolorimetric ones, and the methods which use absorption in the ultra-violet and infra-red range.

With six assistants in the Medical Examiner's Office of New York City, we analyze the organs of about 3,000 cases each year. During my 35 years in the Medical Examiner's Office, I have, with my assistants, analyzed specimens from over 100,000 bodies. Among my assistants, past and present, I am pleased to mention Doctors A. W. Freireich, H. Freimuth, L. Goldbaum, C. J. Umberger, L. Ellerbrook, I. Sunshine, F. Rieders, J. O. Baine, Major S. Kaye, Mr. H. Schwartz, and Dr. M. Feldstein.

I will review a few actual cases from our files which toxicological analyses helped to solve. I will not describe straightforward cases of poisoning, because they lack interest, such as the case of a woman that wanted to do away with her husband. She put sodium fluoride into potato pancakes. The fluoride was found in the body of the deceased husband, pancakes recovered from the garbage also contained fluoride.

Much more interesting are some of the following cases:

The Absence or Presence of Carbon Monoxide in the Blood of the Deceased Is of Great Importance in Solving a Case

In order to get carbon monoxide into the blood, one must be in contact with carbon monoxide containing atmosphere. This may come about through the combustion of wood, coal and oil, the fumes of fires in buildings, automobile exhaust gases, and carbon monoxide containing illuminating gas. Further the person must be breathing when in contact with these gases. If a dead body is placed into a carbon monoxide containing atmosphere even for 96 hours, no carbon monoxide will diffuse into the blood of the heart.

An Apparent Suicide by Gas Was Proven to Be a Homicide by Suffocation

A man, his wife and three children nine, seven and two years old, lived in a lower East Side Manhattan tenement. On the particular morning in question the father left the home about 7 a. m. About 7:30 a. m. one of the boys noticed the odor of illuminating gas. He ran into his mother's room and found her in bed. He shook her, but she did not respond. The boy called for help. The neighbors called the police who in turn notified the Medical Examiner's Office. On arrival of the Medical Examiner, he found the room filled with illuminating gas. The gas jet was open. The woman was dead in bed, lying on her back in a natural position. There was no pink coloration of the skin of her face, or any other part of her body (as is usual with carbon monoxide deaths). Lying in a crib next to the mother's bed was the two-year-old baby, still alive. The baby was quickly removed to fresh air and saved. The absence of pink coloration of skin of the woman, and the fact that the baby was still alive and the mother dead, made the Medical Examiner suspicious, and an autopsy was performed.

The toxicological analysis of the blood removed from the heart of the deceased mother showed the absence of any carbon monoxide. This indicated that death was not due to inhalation of illuminating gas. The autopsy further showed that death was due to suffocation. Ten finger marks of compression were found on the back of her neck.

This man murdered his wife for insurance money. He held her face against the pillow until she was dead. He then turned

her on her back, straightened out all of the bed sheeting, turned on the gas and left the house.

Coroners or inexperienced county physicians would most likely have signed the case out as suicide by inhaling gas, whereas it was murder by suffocation.

A Charred Body

Late one chilly night, March 27, 1937, a police officer was covering his patrol, which traversed a stretch of vacant land, along the river front of New York City, in the vicinity of the West Sixties. As he walked along, he observed in one of the debris-strewn lots a smouldering fire. Homeless men, human derelicts, some through their own error, some through misfortune, frequented this particular locality. Night and day they gathered there, built fires for warmth and companionship, shared the food they begged or managed to find, and too often imbibed in the cup, that for them brought temporary peace and forgetfulness. Fate or chance drew the policeman over to the dying fire in which to his horror and amazement he came upon the charred body of a human being. He summoned the Medical Examiner, who arrived shortly at the scene, and ordered the entire mass of charred material (the body) to the morgue for detailed examination. This procedure seemed like a useless task, engendering long hours of labor over an autopsy table, and more hours in a laboratory, since everything pointed, or seemed to point, to a death caused by fire, as a result of having fallen into the blaze while in a drunken stupor. Nevertheless, the work was begun, upon the unknown pitiful thing that once breathed and lived as man. Examination of the charred cadaver at the laboratories revealed that the body was that of a male. The entire surface of the body was burned and black from charring. The arms and legs were found separated from the trunk. Examination revealed that these separations were not the result of a fire, but were due to post-mortem dismemberment, by means of a sharp instrument such as a knife and a saw, because the points of separation were sharp and clean cut, proving that the man was dismembered before being put into the fire.

On scrutinizing the entire surface of the body, no evidence of any clothing was found. In all cases where clothed human bodies had been burned, to as great a degree as this one was, definite evidence of the clothing in the form of burned and

charred fibers are always found. Those portions of clothing that are underneath the body are preserved the best. The reason for this is that in these places they are protected somewhat from the oxygen of the air, and hence combustion does not go on as rapidly as in those portions to which the air has full access. The absence of all traces of clothing indicated that the man was burned in the nude.

A piece of badly charred burlap (about two inches in diameter) was adhering to the body; and many much smaller charred areas and fibers of burlap were found. These findings indicated that the cadaver was wrapped in burlap, or was put into a burlap sack before reaching the fire.

Examination of the head revealed that the deceased had suffered a severe fracture of the skull, produced by a blunt instrument. This fracture occurred ante-mortem, because of the large amount of hemorrhage found in that portion of the brain. The injury to the brain was so great, that there was no question, as to this being the cause of his death.

Although practically all of his hair had been completely burned, and charred, we were able to find a few hairs on the back of his head, which had been fairly well preserved. On microscopic examination, these were found to be of Negro type. Examination of the mouth revealed buck teeth, strong, white and well kept.

The brain was removed and chemically analyzed for alcohol. The results of the analysis revealed an amount of alcohol (two plus) which meant that the man had been drinking a little before his death. He had not imbibed so much as to make him drunk.

The head, trunk and limbs were assembled together and measured. It was found that the height of the deceased was five feet and eight inches. The assembled parts were then weighed, and, allowing for loss by volatilization during charring, it was found that the deceased had weighed between 150 and 155 pounds.

The femur and also the humerus (long bones of thigh and arm, respectively) were then sawed through longitudinally, and examined, the object of this being to find out whether the deceased was a youth or an adult. During the years of growth there exists an area of cartilage which runs as a band (epiphyseal line) across the neck of the long bones. It is at this locality that the growth of bone occurs. At the age of about

twenty years the epiphyseal line gradually diminishes; and at the age of twenty-five to thirty it entirely disappears. In this case the epiphyseal line was barely visible, which indicated the man was between twenty-five and thirty years of age.

The trunk was then autopsied, and the organs (liver, spleen, kidneys, lungs, heart, etc.) removed and studied. All were found to be normal.

Some blood from the heart was then removed and chemically analyzed for carbon monoxide. Carbon monoxide is a gas produced by incomplete combustion. The gas is therefore found in the vapors, fumes or smoke of stoves, heaters or furnaces (both coal and oil burners), of automobile exhaust gases, and in fires in general. If a living person comes in contact with these gases, he inhales them, and the carbon monoxide reaches his lungs. In the lungs the carbon monoxide combines chemically with the pigment (haemoglobin) of the red cells and is thus carried by the circulation to all parts of the body. It is due to this reason that we find carbon monoxide in the blood of the heart, in every case that is burned to death. On the other hand, if a dead body is put into a fire, there is no breathing, no circulation, and therefore no carbon monoxide reaches the heart blood. In the case at hand no carbon monoxide was found in the blood, further corroborating that the man was dead when thrown into the fire.

The scientific study of the cadaver convinced us that a crime had been committed. We therefore informed the police homicide squad of the results of our findings which we embodied in a report as follows:

> A male Negro, age twenty-five to thirty years, height five feet, eight inches, weight 150 pounds, having buck teeth met death by being hit on the head by a blunt instrument, producing a fracture and severe injury to the brain. When he was dead, the clothes were removed from his body. His limbs were then dismembered by knife and saw. The head, trunk and limbs were put into a burlap bag, taken to the Sixtieth Street scene and thrown into the fire.

On receiving this report, the police authorities automatically took hold of the whole matter. At this juncture, news of the finding of the body and the particulars of the case had reached the public by way of the press, and in the neighborhood where the happening occurred gossip flew swiftly back

and forth. Several days had elapsed when an intelligent and quiet spoken Negro woman, about thirty years old appeared at the city morgue, and asked for permission to view the body of the man found dead in the lot at West 60th Street. A reason for her request was demanded. She replied by saying that she feared he might be her cousin. They had grown up together as children, in a small southern town, and were more than usually attached to each other. He visited her home nearly every day, surely every other, and now for the space of two weeks she had not seen him. Moreover, a Negro man who resided a few doors away from her, but whose name she did not know confided to her that he suspected that the deceased was her cousin. The following day, accompanied by detectives, this woman found the Negro, a carpenter, who did odd jobs here and there. He told the sleuths that he based his suspicions upon what he saw one evening while returning from work.

A Negro cook, whom he knew, and the cousin of this woman were engaged in a heated argument; they soon resorted to blows, and finally the cook invited his opponent up to his quarters, a room in a house nearby, to finish the fight. For at least two hours, the carpenter remained below in the street, awaiting the return of the fighters, but they did not appear, and everything having quieted down about the place, he left for home, but he was still inquisitive about the finish of the affair. Furthermore, it had been customary for him and this woman's cousin to meet each day in a lunchroom, but so far he had not seen the latter since the night of the affray.

The police now armed with the autopsy findings, and having investigated more or less the stories told them, set out to track the suspected man. They gained access to the cook's home during his absence. Their first find was a clothesline in the back yard, hung with washed clothing, a suit, shirt and underwear, identified as belonging to the deceased. Examining the kitchen, they found it neat and clean; they came across a floor mop, a large knife, hatchet, hammer and saw hidden away in a closet. All these articles, along with the clothing, were sent to the chemical laboratories. As a last precaution, the scrubbed oilcloth was ripped up from the flooring, and sent along for analysis. After the chemical and serological tests were completed, it was found that all articles showed the presence of human bloodstains of the same type as that of

the deceased, including the oilcloth, the blood having seeped through the joinings, leaving its telltale work on the seams underneath.

On being confronted with the evidence the cook cravenly admitted his guilt. He killed the victim with a blow from the hammer, dismembered the body the next day, wrapped it in a burlap bag, and after midnight deposited it in the fire when the streets were deserted. The courts convicted him to a prison term of twenty years on a plea of manslaughter. He is now serving the sentence and if it were not for the protection and vigilance which the office of the Medical Examiner affords its citizens, he would be a free man with bloodstained hands mingling with the innocent.

Cases Involving Suspected Drowning

The laboratory test for drowning depends upon the fact that in persons drowned in salt water the chloride content of the blood in the left heart chambers is higher than that of the blood in the right heart chambers, while in fresh water drownings the picture is reversed. In persons that have not drowned, the chloride content of the blood in the left heart chambers and in the right heart chambers is the same.

Suspected Suicide Pact Was Proven to Be a Double Homicide

A man and wife were found in the Hudson River off the shores of Manhattan. It seemed to be a suicide pact. An autopsy was performed. The chemical analysis of the blood from the left and the right heart chambers indicated that the couple were not drowned. The autopsy revealed that both had fractured skulls and lacerations of the brain, indicating they were murdered. Following the medico-legal findings, the police took up the investigation and apprehended the perpetrators. They were convicted of the charge. The motive was robbery and business jealousy.

A Suspected Drowning Case Was Proven to Be a Suicide by Poison

A 32-year-old woman was found in a bathtub, one-half filled with water. The autopsy revealed no cause for death. The chloride content in the blood of the left and right heart chambers was the same, indicating that death was not due to drowning. A further chemical analysis revealed the presence

of nicotine in the organs. She had taken "Black Leaf 40" for suicide.

A Drowning Case Proven to Be a Suicide and Not Accident

A 51-year-old man was pulled out of the river. The blood chloride of the left and right heart chambers indicating drowning. The stomach contents and organs were analyzed and large amounts of "Lysol" were found. This indicated a suicide rather than an accidental drowning.

Putting the Finger on the Perpetrator of a Crime

A physician called up our office and reported that a woman, aged 28, had suddenly died in his waiting room. One of our Medical Examiners went to the scene. The physician told him that this was the first time he had seen the woman. He had not treated her. According to the physician the woman told him that she had an abortion performed by someone, and as she was on her way home she became very ill. She entered the physician's office to obtain relief. As she was telling this to him, she suddenly collapsed and died. The Medical Examiner became suspicious. He examined the premises for any evidence of an abortion. None was found. All instruments, everything was perfectly clean. He then ordered the body to the morgue. On autopsy, it was found that the woman had died from hemorrhage due to an abortion. The question before us: Was the abortion performed in the premises of this physician? The organs were submitted to me to be analyzed for ether, chloroform, procaine, pontocaine, barbiturates, etc. I found present, 78 mg. of chloroform in 500 g. of brain. Our previous experiments in chloroform anesthesia revealed that a person is completely anesthetized when the chloroform content of the brain is between 50 and 90 mg. in 500 g. of brain. The finding of 78 mg. definitely proved that the woman was anesthetized at the time of her death. She could not have walked the streets as the physician contended. He was indicted, tried and convicted of the abortion.

Piece of Bloodstained Newspaper Pointed to the Murderer

The body of a six-year-old girl was found in a burlap bag on the front stoop of a residence. In the grasp of her left hand was a small piece of crumbled newspaper with bloodstains. The body was autopsied. It was found that she was attacked

and strangled. We suggested to the police to keep in mind newspapers with bloodstains. The police then inquired around the neighborhood about any suspicious characters. Among these was a barber one block away from where the body was found. They searched his premises. In a room in back of the barber shop, behind the radiator they found a soiled and bloodstained newspaper. The blood on this newspaper, the blood on the piece of newspaper in the girl's grasp and the blood from the body were all of the same type. We also pieced together the portion of the newspaper in the child's grasp with that found in the barber's room. This pointed definitely to the barber as the murderer. He was convicted.

Stomach Contents Only Means of Identification of Murdered Woman

A man whose wife was fat and unattractive, had affairs with other women, and his wife heard about it. She made life pretty miserable for him, upbraiding him constantly for his infidelity and imploring him in the name of their three small children to be a good father and husband. So he decided the only thing to do was to get rid of his wife. He and a pal of his concocted a not very imaginative murder plot which they executed. On the morning of April 6, 1922, as he left for work as a taxi driver, he told his wife to dress up that night, that he was going to take her to a party. She spent the day dolling herself up the best she could, ironing her dress and fixing her hair and doing things to her face—pitiful efforts to lure her husband away from the pretty twenty-two year-old blonde which neighbors told her he was crazy about. He was in high good humor as he drove his wife to the home of some friends. He even gave her three cents to buy some candy for the children. They had a good time at the home of these friends, and she was happy that her husband seemed so attentive. Towards midnight they left. Driving home, the taxi driver told his wife that the engine seemed to be developing trouble, and upon sighting his pal standing on a corner (by prearrangement) he asked him to get in the car, telling his wife that this pal would help him fix the car. The three of them drove to a lonely lot, where the taxi driver stopped the car. The wife was skeptical about the engine trouble. Her husband got out of the car, lifted the hood, and called to his wife "Come here, and I'll show you what's the matter."

Let the pal take up the story: "She leaned over with her back to him, and he hit her with the iron bar. She fell down; then he pulled her coat tight around her head (that was to stop her yelling). She didn't yell, though; she just groaned. He grabbed her by the back of the coat and dragged her to the edge of the pit he had dug that day in the vacant lot. It was about thirty feet away. He told me to keep a look-out, and I went back to the sidewalk. He was shoveling dirt on his wife. She was still groaning. It took about half an hour to get her buried. Then we swore over the grave never to tell anybody, and we went to the lunch wagon, where he set them up to cigars."

The neighbors noticed this woman's continued absence. Her husband explained it by saying she had gone visiting to Philadelphia. After a week he showed them a telegram reading: "Everything OK with me letter will follow." A few days later a letter came, which he showed around: "Dear Husband—This is to inform you that I have gone away with another man to whom I was married to before I married you. He said he would arrest me for bigamy if I didn't go with him. I hope you will be a better father than I have been a mother. I remain your ungrateful wife." That quieted the neighbors' suspicions, and things went smoothly for about six months. Then one day a body was discovered buried in lime in a vacant lot near the Bronx home of this taxi driver. The body was in terrible shape, almost completely unrecognizable. The Medical Examiner estimated that she had been dead about six months. The discovery of the body revived the neighborhood gossip, and the police, who get around, presently got wind of it. They found the taxi driver, and took him down to the morgue.

"It don't look like my wife," he said. "She was a bigger woman. But I just don't know. I couldn't say yes, and I couldn't say no. How could anyone say who that was?" Detectives remarked on his coolness. He took the attitude of wanting to be helpful but not being able to.

The police started an intensive investigation. Before long they were completely convinced that the taxi driver and his pal had murdered this woman. They even found the man in Philadelphia to whom the taxi driver had paid ten dollars, to send the wire and write the letter. But they knew it was useless to try them for the murder unless they could positively identify the body as the wife of the taxi driver. They

and the Medical Examiner tried everything: clothing, dental work, laundry marks—but none of these attempts led to a positive identification.

Then came the break. The author analyzed the stomach contents, looking for a lead or a clue. He found traces of oranges, raisins, cherries and almonds in the woman's stomach. This discovery electrified the detectives into action. They went to the friends who had entertained this couple the night the wife disappeared. "Did you have anything to eat at that party?" they asked casually. "Yes," was the response, "we had oranges and cherries, and, let me see, oh yes, we had some almonds and raisins."

That was enough. They put the two men on trial for the murder. The pal confessed, but the husband denied everything to the last. But the jury chose to believe the evidence of the microscope and the laboratory rather than his denials. They were both convicted and electrocuted at Sing Sing.

The taxi driver's last words were: "If I ever get out of prison I will get even with that District Attorney."

It would have been more to the point if the man had directed his ire against the toxicologist. The oranges, almonds, raisins and cherries were what sent that man to the chair.

The Absence of Chloroform in the Brain of a Baby Convicted the Murderer

A man living in a small town on the border of one state had an illegitimate child by a girl in a nearby town but situated in an adjoining state. The mother of the girl requested him to marry her daughter or at least to support the child. The man answered that he would gladly take care of the infant. A few days later he hired a buggy and drove to the girl's home. He took the child and promised to take care of it. About two weeks later a baby was found floating down a nearby river. It was identified as the child belonging to this man. He was taken into custody and questioned. He admitted having killed the child. The description of the manner of his killing, however, was remarkable. He stated that when he left the home of the girl with the child, he put the infant into a sack with a rag saturated with chloroform, tied up the sack, put it into the back of the buggy, and then drove toward his home across the border of the two states. He stated that he could not tell when the child actually died. That statement

was very remarkable as he either was very well conversed in matters of criminal law, or he obtained the advice of a lawyer. For it is a matter of law that the defendant must be tried in the state in which the murder was committed. In this case, according to his statements, there was no way of telling in which state the child died. In order to ascertain the actual facts about this death an autopsy was performed. The various organs of the baby were analyzed by the author. No trace of chloroform was found in any of the organs, especial attention being laid upon the analysis of the brain, as this organ absorbs most readily and holds for many months after death any chloroform that may have been administered. Marks of violence were found on the face and neck of the child. The suspected murderer was confronted with these scientific facts, upon which he completely broke down, and admitted that he killed the baby by strangulation, and told just where he enacted the murder. The outstanding feature of this case is that a coroner or even an ordinary physician might not have had sufficient training and experience to consider the advisability of analyzing the organs for the presence or absence of chloroform. Through inexperience they might argue that by inhalation the child got very little chloroform; and further, the body being decomposed after two weeks of exposure to hot weather and chloroform being very volatile, it would have escaped after such a long period. It is true that the brain was very much decomposed, in fact, converted into a mass resembling a liquid mush. A series of very delicate and well controlled reactions was made and the absence of chloroform was proven. In answer to the question whether the chloroform administered may not have disappeared in the two weeks' interval, experience in numerous other cases, and in animal experimentation, have proven definitely that chloroform under the identical conditions cited in this case, will remain in the brain for many months and may readily be detected.

Chemical Analysis Saves One Indicted of Murder Charge

A policeman along the waterfront noticed a man with a large bundle intent upon throwing it overboard. On opening the bundle, the officer found the torso of a woman. The head, arms and legs were missing. They were picked up the next few days in various parts of the city. The man was questioned

at the station house. He gave his residence and stated that he lived with this woman as common-law man and wife. They had been drinking and they quarrelled. He then left the house. The next day when he returned he found his wife dead on the floor. He was afraid that the police would charge him with murder, so he proceeded to dismember her and then to do away with the remains. Meanwhile, the neighbors in the house discovered that illuminating gas was coming from the room in which the two lived. They broke in the door, found the woman on the floor as the husband stated. They also found that the coffee pot on the gas stove had boiled over and put out the gas flame. The gas filled the room. The chemical analysis of the blood gave a 62% carbon monoxide saturation. The analysis of the brain gave 0.35% alcohol indicating intoxication. The man was evidently telling the truth. The woman was intoxicated. She was trying to make some coffee; she did not notice the boiling over. She was overcome by the carbon monoxide and collapsed. The man was cleared of the murder charge although he was held for dismembering a human body.

On So-called "Experts"

An elderly, well-to-do couple had just returned to their suite of rooms in the annex of a first class hotel from a short vacation at Palm Beach. The next morning both were found dead in one of the rooms. No clue as to the manner of their death could be unearthed. Many curious theories were put forth, among them that some one had injected some rare poison into some plums which they had eaten. The autopsies of the two bodies revealed nothing specific as to the direct cause of death. The author analyzed all the organs for all conceivable poisons but found them all absent. During the application of a series of the most sensitive tests, however, he did get a faint indication of a very small trace of cyanide. Upon this lead the lungs were now examined, using larger portions, and especially concentrating on the cyanide reactions. After much painstaking work, reactions were finally obtained which proved without question that death of both people was due to hydrocyanic acid gas, originating somewhere in the hotel. The authorities then got the admission of the manager that a fumigation had taken place on the

floor below. The gas diffusing into the upper apartment killed the two people. No sign of danger had been posted. The case came to trial. The author testified his findings as above related. The defense hired two experts. One, a physician doing X-ray work, gave testimony as an expert pathologist. The other, a professor of chemistry in one of the technical institutes, gave testimony as an expert pathological chemist and toxicologist, yet himself admitted on the stand that he never before saw an autopsy nor had he ever analyzed a human organ. When asked what is meant by the science of pathology he answered it is the science of poisons. Upon this answer the district attorney said to the witness: "The answer which you have just made is as true as all the others you have made upon this witness stand." It was testified by one of them that cyanide was not poisonous under certain conditions; it was testified that all lungs will yield cyanide in measurable quantities, because they contain carbon, hydrogen, and nitrogen; they testified that they could produce cyanide from normal lungs by simply letting them stand in a flask for a few hours. Further, that they had allowed a guinea pig and a white mouse, both sick, to breathe fumes of hydrocyanic acid gas and the more they partook of the fumes, the better they liked it; they began to eat more and more and finally got well from their original sickness. Such statements were testified to without the least restraint. The jury finally acquitted the defendant. A case of this kind well serves to show the poor system we have when it comes to expert medico-legal testimony. Many scientific witnesses think only of winning the case for their side, thereby stretching their testimony so far that it becomes false. What can one expect the jury to do when the experts on one side say a thing is white and those on the other that it is black?

So-called "Experts" Again

A man was said to have died suddenly although investigation showed he had been sick on and off. Due to small town gossip that his wife poisoned him, the state's attorney ordered the funeral to be postponed and an autopsy to be performed. The organs were submitted for chemical analysis to a Doctor who admitted he had never analyzed the organs of a human body before. He found cyanide present. The wife was in-

dicted for murder. I was retained by defense lawyers to advise them at the trial. We requested some of the organs to check on the analyses, but were told they had no more left. Among the several bizarre statements made by the state's expert, the outstanding one was the following: He testified that he found a trace of cyanide in the brain but he found no cyanide in the stomach contents. This statement ruined the state's contention that the woman gave her husband cyanide by mouth. In all cyanide poisonings, one dies within 5 to 15 minutes, and therefore we always find about 60 to 70% of the cyanide in the stomach contents. He was then asked how many tests for cyanide he performed on the stomach contents. He answered only one, the Prussian blue test. He admitted having done no duplicate, he only did one test. The next day, he was put on the stand again. He changed his original testimony. He said there was cyanide in the stomach but he did not find it because he did the test wrongly. Said the defense lawyer, "if your test was wrongly done why did you not repeat the test?" The expert now said he had repeated the test. He was asked "How many times did you repeat it?" He answered fifty times. "So you repeated the test fifty times and did it wrong fifty times and therefore you did not find the cyanide?" "Yes." "And still you maintain that cyanide was present?" "Yes." Such testimony is really unbelievable. How can you convict a woman when the state's expert testifies that there was cyanide present but he he did not find it because he did the test wrong fifty times? The woman was acquitted.

Chemical Analysis Disproves an Alibi

A woman living in Factoryville, Pennsylvania, disappeared on March 28, 1950. She was never seen thereafter. Her husband said she had gone to California. This the police disproved. On March 7, 1951, (about one year later) the police found a wash boiler, full of concrete, buried in the cellar of this man's house. On chopping away the concrete, they found the head and one-half of the pelvis of his wife. On questioning by the police the husband stated that his wife had committed suicide with pentobarbital. Then being afraid the police would pin a murder rap on him, he decided to dismember her and burn her up in the furnace. The head and pelvis he put into the wash boiler and covered same by pouring in the

concrete. The district attorney requested that I analyze the muscle on the pelvis for pentobarbital. The brain I was told had been discarded by the pathologist because it had liquefied. Upon analysis of the muscle (460 g. available) not a trace of barbiturate was present. The muscle had kept very well because it had been imbedded in the concrete. In the usual run of fatal barbiturate poisonings, we find per 100 g. portions about one-half as much in the muscle as in the brain or liver. This finding proved that the man was lying when he said that his wife committed suicide with pentobarbital.

I testified to my finding at the trial, also as to the lethal dose, and what quantities of pentobarbital would be found in organs and muscle from a lethal dose. In order to impress the jury, the district attorney brought in a physician as an expert. Among his statements on the witness stand was the following: "Nobody ever died from excessive doses of pentobarbital. If Dr. Gettler knows of any such cases he is the only one that does." You see this so-called expert wanted to tell the jury that even if this woman took large quantities of pentobarbital she would not have died from it.

Overtrying a Case

A 24-year-old married woman, healthy, 6 months' pregnant, was under a doctor's care. At 9 p. m. on December 7, 1943, after her husband (a druggist) gave her a cough mixture prescribed by her physician for a slight cold, she developed typical strychnine convulsions. Removed to the hospital, her spasms continued, but gradually decreased after she was given calcium gluconate and bromides. No more convulsions occurred after 10:30 a. m. on December 8, and for 16 hours thereafter. At 2:30 a. m. on December 9, a nurse gave her 5 ounces of Calcium Chloride in elixir lactated pepsin (prepared by her husband in his own drugstore and brought to the hospital). Within one-half hour she had a series of convulsions and died at 4 a. m., December 9. Three physicians in attendance diagnosed the case as toxemia of pregnancy. The body was buried unembalmed. Due to the suspicions of the sisters and brothers-in-law, that the deceased, as also her mother, who died at home with identical convulsions about one year previously, had been poisoned, the district attorney ordered the exhumation of both bodies. Lethal quantities of strychnine were found in both bodies.

In the case of the mother, no indictment was possible because the poison was administered in the home and she died at home. Any one of her sisters or brothers-in-law could have given her the poison. Had the wife died from the strychnine administered to her at home, the district attorney could not have proven who gave it to her for the same reason. The wife, however, survived the dose given her at home. She had intermittent convulsions for about 12 hours, then recovered. She had no more convulsions for 16 hours until the nurse gave her the medicine prepared by her husband in his own drugstore and brought to the hospital. She convulsed and died in about one hour after taking the medicine. The next morning the husband appeared at the hospital and requested all containers and medicine that were left. The unsuspecting nurse gave it to him. It was the contention of the district attorney as well as that of Dr. T. A. Gonzales, Dr. Burton Opitz and my own, that the strychnine that produced the sudden onset of convulsions and death, was administered in the hospital, probably through the medicine prepared by the husband. He was convicted of first degree murder. The Court of Appeals threw it back on technicalities. He was tried a second time. The Court of Appeals rejected it again. He was tried a third time. The jury acquitted him this time. Some time thereafter the defense lawyer gave a lecture in which he stated the reason for the acquittal was that the district attorney overtried the case by bringing in an additional expert. On cross-examination this expert was asked whether he knew of Thienes and Haley's, "Clinical Toxicology." He said, "yes." "Do you consider them authorities?" He answered in the affirmative. Then defense lawyer read into the record a passage in the book "Fatalities [from strychnine] as early as five minutes and as late as 48 hours have been known." Notice the authors did not include that some convulsions occurred during the 48 hours. On summing up, the defense lawyer brought out that a person may die as long as 48 hours after getting the strychnine with no convulsions during this time. In the case at hand, only 16 hours elapsed without convulsions and, therefore, the strychnine was administered in the home. The error into which the expert was drawn was to admit that the writers of the book are authorities. Authors of textbooks are not authorities on everything

printed in their books. Had the expert refused to acknowledge that the book by Thienes and Haley was an authority, the passage could not have been read into the report. When I was cross-examined, I was confronted with the same queries. My answers prevented the defense lawyer from introducing any passages from the book.

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Trauma and Tumours*

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My remarks are directed more towards the medico-legal rather than the strictly medical aspects of the problem, and will be in the nature of an attempt to determine the reasons for the confusion and conflict that exists between the physician and the lawyer in the matter of causation, as it concerns the subject under discussion. It is hoped thereby to provide a better interpretative background, against which both the lawyer and the physician can individually project his ideas, and while not necessarily coming to any common agreement, at this time, can at least understand each other's thinking on the matter. If this initial step meets with any success, it might even be possible later to approach a common ground of agreement on certain, if not all, of the conflicting viewpoints in this field in which medicine and the law have common responsibilities to society at large.

Neither time nor inclination permits of a repetitious review of the accumulated body of scientific medical knowledge dealing with the experimental and clinical evidence of the relationship between trauma and tumours, more especially malignant tumours. One cannot help but remark, however, that the general interest in the subject has been focussed in the past not so much on the fundamental scientific problem as to whether trauma can and really does cause new growths, as on the more eminently practical and at times lucrative matter of attempting to obtain financial awards in the courts, in cases dying of malignant disease, in which a factor of trauma can be alleged or established as proven. In other words, the real day-to-day interest and importance in the matter of relationship between trauma and tumours lies more outside of the field of medicine and resides largely in the field of law.

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In saying this, it is not to deny that medicine has a responsibility to investigate this problem; indeed it has long since realized this and as a result, a body of sound experimental and reasonably accurate clinical evidence has been compiled Thus evidence to date on the experimental level fully establishes certain relationships between trauma and the development of experimental tumours. It shows, for instance, that a single trauma in the sense of an injuring force of whatever type or nature, be it mechanical, chemical or thermal and exclusive of ionizing radiation, leading to a dissolution of tissue continuity at the site of injury and exciting the usual response of inflammation and repair, does not produce a benign or malignant new growth. On the other hand, there is abundant evidence to show that trauma of a kind occurring over a prolonged period of time, be the agent of a physical or chemical nature, can and often does produce benign and malignant new growths.

In each of the above instances, where the traumatic factor is either solitary or prolonged, the host tissue on which the factor acts, apart from its inherent susceptibility, is presumed to be normal and intact in all respects. If, however, as a result of previous conditioning, from whatever cause, the host tissue is not in fact normal, then there is strongly suggestive evidence that a single injury can produce a malignant growth. The best example to illustrate this, described as the principle of co-carcinogenesis, is that of a recently reported case (1) of a worker of sixty years of age in the refined petroleum oil industry, who by the nature of his work, had his hands exposed to carcinogenic agents in the oil for a period of thirty years, and who developed a squamous cell carcinoma 1.7 cm. in diameter, at the exact site of a cutaneous laceration on his hand received thirty days before, at a time when his skin had shown no preceding evidence of abnormality according to the case report.

This type of case, where known carcinogenic agents are present in a working environment, and where these agents by themselves will readily produce cancer in an appreciable number of workers in the environment after long-continued exposure, is readily acceptable by both the medical and legal professions as an authentic example of trauma leading to the development of a malignant tumour.

The only reason for our ready acceptance at this time of this type of case report, however, is because of our current knowledge of occupational carcinogenesis. In passing I venture to say that if this case had been litigated thirty or so years ago, many of our most outstanding medical experts of that time would have categorically denied any causal or contributory relationship between the cancer and the single injury, because at that time, knowledge concerning the extent of the distribution of carcinogenic agents in industry was not well established, nor was there then available the body of experimental evidence relating these agents to the production of cancer, such as we now possess.

This matter of changing concepts of disease on the basis of current medical advances is one that bears strongly on the perennial difficulties encountered between medicine and the law. The medical expert is bound to stay within the limits of knowledge in his field when he appears in court to testify, and it requires little thought for him to recognize that there are many gaps in the available current knowledge about any medical subject. Therein lies his vulnerability, which the clever lawyer knows only too well, and accordingly pursues fully for the benefit of his client.

Assuming the role of the devil's advocate for a moment, I should like to point out how mistaken the doctor frequently is in his estimate of the legal process. Unfortunately, we find at times amongst us in medicine, the type of physician nurtured in the rarefied atmosphere of the medical school or hospital or research institution, and conditioned beforehand in the narrower limits of the academic environment—who resents what he considers to be a rebuff to his carefully considered opinions at the hands of the equally carefully prepared lawyer—and who, as a result, withdraws from one of his medico-social responsibilities by shunning the law courts for the rest of his professional days. The basic foundation for this action on the physician's part lies in the fundamental differences between the two professions in their approach to a problem involving both legal and medical issues. In medicine, the physician thinks of the cause of a disease in terms of its inciting agent; to him, the tubercle bacillus is the cause of tuberculosis, while in the instance of cancer, there is as yet no known cause as he understands it. Similarly, the physi-

cian envisages the course of a certain disease as following a certain generally accepted clinical pattern, and finds it hard to admit the existence of any extraneous factor in the environment as being operative in affecting such a course, especially when there is no clinical evidence of change in the predictable pattern attributable to the action of this extraneous factor. This is all very well as far as it goes in medicine; the difficulty is that in the case of the law, it does not go far enough.

In this connection, one of the bones of contention between the doctor and the lawyer lies in the field of semantics, and concerns their respective concepts of certain word images. For example, the word "sanity" has different connotations, depending on whether it is used in the medical or legal sense. Similarly, the word "cause" means one thing to the physician dealing with disease, and another to the lawyer concerned with the legal concept of causation in workmen's compensation and in tort. It is an interesting fact that as time has progressed, the lawyers and the doctors have more or less accepted each other's conception of the word "sanity" and have agreed to go their separate ways in recognizing the difference in definition between medical and legal sanity. Not so, however, in the case of "cause" where at present there still exists a wide difference of opinion between "cause" in the medical and "cause" in the legal sense.

There is no need to elaborate on the medical concept of "cause" to a group such as this, but it might be well to attempt an understanding of the term when used in a legal sense, for it is this basic difference that has led in the past to such confusion and acrimony in court, especially in the much litigated question as to whether trauma can "cause" a tumour.

Thus, Webster's Dictionary defines "cause" as used in law as "A suit for action in court; any legal process by which a party endeavours to obtain his claim, or what he regards as his right; case; ground of action." With this definition in mind, it immediately becomes apparent that the lawyer places an entirely different connotation on cause than does the physician. This legalistic viewpoint is aptly expressed by Ben Small (2), Professor of Law at Indiana University and the author of the recently enacted Workmen's Compensation Law of Indiana (1950), in an article in the Texas Law Review (June 1953), entitled "Gaffing at a thing called Cause: Medico-Legal conflicts in the Concept of Causation." Thus he quotes

the definition of the term "legal cause" in tort as "one used to denote the fact that the sequence of events through which the author's tortious act or omission has brought about (in fact caused) the harm which another has sustained is such as to make it just to hold the actor responsible therefor" (Harper; Law of Torts 258 (1933)). This definition in a sense elaborates on that of the dictionary defining cause as "ground of action." In the case of workmen's compensation, he points out that the phrase "Arising out of and in the course of employment" as a ground for legal cause is so loose in relation to cause and effect, as to require the employer to pay for whatever injuries or injurious conditions that can be so labelled. Small compares the existing differences between the scientific approach of the doctor on the one hand based on his knowledge of the pathogenesis of disease, and the approach of the lawyer on the other, whose interests are outside the field of pathology, and whose function is that "of identifying influences toward legal responsibility for harm which may lie in the habits and behaviours of the surrounding society in which harm and his pathological risks are cast." Furthermore, in pursuit of this function of identifying influences toward legal responsibility, "He must find the tort most deserving of the costs of harm, be it the victim's or another's." In elaboration of this, he sets up a working definition of the law as follows: "Law is a concept, an abstract term of concept, representing a system of adjustment toward social harmony and accomplishment in an ordered direction." With this somewhat abstruse definition as a springboard, he proceeds to explain what is meant by "cause" in the lawyer-sense, namely, that in the process of adjustment toward social harmony, certain *policy considerations* springing from social demands will control the adjustment process and then be related to the cause. He then declares what these policy considerations are; namely, "to shift the burden from the victim to another if the other's part in the occurrence of harm was sufficient to make it appear that he *ought* to pay for it." In the preparation of his case, the lawyer seeks to lay an element of responsibility at the door of the defendant by establishing that a risk was created by him which led to the harm of the plaintiff. If such a relationship seems likely of establishment, then the lawyer has grounds for a cause of action. However, the element of causation imputed to the defendant "need not have been the

sole cause or even its principal cause, but only a cause of sufficient proportion, in the light of his conduct, to make it seem just for him to shoulder the cost. If such a sufficiency of relationship can be established, it is dealt with in lawyer parlance as legal or proximate or responsible cause. . . ." He goes on to say, "Such a concept of cause by no means excludes or overlooks others; nor does it in any way define the source of the harm. . . . Just as in criminal law a culprit may be guilty of murdering a dying man, a defendant in tort law may, on the basis of his risk creation, be liable for a harm built from many causes."

From the above, it is evident that the concept of cause in the legal sense has no common meeting ground with that of cause in the medical sense and that the sooner this fact is recognized, the better will be the inter-relationships between the lawyer and the doctor in court. For one thing, it should put an end to many of the pontifical and sometimes not too pertinent remarks of some of our medical brethren, who, lacking the appreciation of this difference, are wont to be caustic in their criticism of the intelligence and even the integrity of those physicians who testify in court, to say nothing of the low repute in which they hold the lawyer who would claim that trauma "caused" a cancer in his client.

This unwonted criticism by our medical purists, frequently voiced in the literature, can be readily appreciated and naturally receives a sympathetic ear from medical people but only when we think purely in terms of the science in contradistinction to the art which after all is the field in which medico-legal matters reside. It is all very well to say as one outstanding pathologist has, that "Attempts to rely on single trauma to explain cancer depend on the exercise of primitive forms of reasoning" (3), but what of the seemingly authentic case of the worker in oil who developed an epidermoid cancer 30 days after a single injury? Might this not actually be a bona-fide example of a scientific fact? Similarly, there are just grounds for medical criticism when reference is made to the worthlessness of hospital histories taken by residents, and the lack of critical analysis or skepticism relative to the statements of patients, as well as to the need for improvement of the methods of questioning patients. These criticisms very rightly point out the flaws in our methods of medical practice

generally, and for that reason should not be cited as a specific weakness in the investigation of those cases in which trauma and malignant disease coexist. It is true that these existing conditions call for definite improvement, but one must be mindful of the fact that in day-to-day living, these conditions are always with us, and as medical people, we have a social obligation to lend our skill and assistance to society in attempting to assist the law in coming to as just a decision as to causal relationship, as the admittedly imperfect evidence in a given case permits. No single case for litigation in which medical facts are involved can ever assume the nature of a controlled scientific investigation, any more than a single case of disease treated by the physician can be assured of an exact diagnosis and specific therapy. Why then should we demand more rigid criteria for adjudicating a medico-legal problem than we do in our routine daily activities in diagnosing and treating disease? It simply resolves itself then to a situation where the physician involved in a legal action of causal relationship between trauma and tumour must do the best with the facts he has at hand and render an opinion based on the evidence coupled with his current medical knowledge. It is an inherent error of reasoning to assume that such an opinion has to be an absolute one—it would cease being an opinion if it were! And here again lies the basis for confusion as to what "opinion" really means. In the medical sense, it is "a formal expression by an expert" (4), a definition to which the physician naturally cleaves and which to him might seem to be in the nature of an oracular revelation at times. To the lawyer, however, the medical expert is nothing more than an opinion witness, and he chooses the definition of "opinion" instead as "a belief stronger than an impression, less strong than positive knowledge" (4). Mindful of this difference then, if the physician would only learn to regard himself and his opinion in the same light as the lawyer's estimate of him and his opinion, his amour propre in court would be seldom violated and his contribution to the case would be considerably enhanced thereby.

It would seem to me then that once these semantic differences in the use of the words "opinion" and "cause" are recognized and accepted by the two groups, and after some sort of truce is declared, leading to a peaceful coexistence in re-

spect to causal relationship, that the doctor would do well to revise and re-evaluate his concepts in the matter of causation and aggravation of malignant tumours by trauma. Admitting that much of the confusion in the past in the matter of causation has been due to each profession misinterpreting the intent and purpose of the other in the usage of the word, would it not be better for the doctor in testifying on the matter of causal relationship between trauma and tumour, to stay within the rigidly defined limits of the experimental and clinical evidence in his field and to cease from speculating on the possible and probable relationships involved in a court case?

Thus, current experimental evidence relating single trauma to causation of malignant growth offers no support whatever for the contention. Similarly, single trauma inflicted on existing malignant disease has not been shown either to increase the rate of growth of the primary tumour or to increase the extent or rate of metastasis, even when the regional metastatic site is prepared beforehand by local trauma (5). There is thus no valid experimental evidence that trauma incites or aggravates a primary growth or increases metastatic disease from the primary site. This experimental knowledge should have evidential value in court, when the physician faced with the hypothetical question as to whether trauma will aggravate the growth of a malignant tumour or will cause it to metastasize or increase its extent of metastases, cites it in support of his opinion. Similarly, he is at liberty to draw on clinical experience and knowledge in denying any relationship between trauma and aggravation of a pre-existing malignant tumour, when the facts in the case show no unequivocal evidence that the growth rate and behaviour of the tumour was in truth any different than that which could have been anticipated in a tumour of the same kind uninfluenced by any intermediary factor of trauma. Unfortunately, this is not always possible in every case, so that at times the physician is forced to admit the possibility even though he is prepared to deny the probability and that on the basis of present knowledge only. Medical opinions reflect current medical knowledge, which is in turn subject to modification and change in the light of advances in the field. Such opinions in a court of law, however, carry no greater weight from the medical witness than any other piece of evidence in the case—frequently one

is tempted to think it currently carries less—so that the doctor should refrain from speculating as to probable and possible relationships and stay within the confines of his knowledge on those cases where the evidence of causal relationship in the medical sense is not clear cut.

As time goes on, the very exceptional case is seen where a single injury does cause or aggravate a malignant tumour, so that at times, the hypothetical possibility does exist in fact, but when this occurs, the chain of evidence is readily appreciated and leaves little need for speculation in respect to cause and effect. Taking this as the basis for positive testimony, the physician in court should not hesitate to express the opinion of lack of relationship between trauma and tumour, if the case does not fulfill the necessary postulates. His attitude in this regard should be no different to the scientist who refuses to accept a bacterial agent as the cause of a disease unless the evidence is such as to fulfill Koch's postulates. If the doctor sticks to the medical concept of causation when he testifies in court, fully recognizing that the lawyer's concept is different from his, he might not be as welcome a witness at times, but he will certainly be a more factual medical expert in both the medical and the legal sense.

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Narco Interrogation*

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This is a PROSPECTUS: an analysis, and an accounting of the methods developed at the University of Minnesota for interrogation of criminal suspects during narcosis. Some accept the challenge we offer, to try our methods, to duplicate, and to improve upon the results we have obtained. My missionary duties will be fulfilled if one will listen to the proposals which follow and recognize the tremendous usefulness this technique has in criminological activities. The possibilities and potentialities we are to discuss are so broad and sweeping that just a brief review and summary are possible today.

Many are aware that the majority of my experience in the field of detecting deception has been with the polygraph. Frequently I have been asked about the limitations of this instrument and about the difficulties in interpretation of some of the recordings. At times we have been confronted with suspects with low mentality, and with others who produce "*inconclusive charts*," as they have been called.

But, on the 28th of September 1948, I began one of the most interesting experiences in more than 25 years in the field of investigation. In essence, a young man with a long record of arrests and convictions was charged with the brutal murder of a boy and girl he surprised in unusual circumstances on a golf course. The conviction of this man finally depended upon locating the murder rifle. Our polygraph examinations disclosed his guilt, and he reacted to any possible location of the rifle which involved a body of water. We were at a loss to select the correct lake, river, or pond into which we could send divers.

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In desperation we turned to the only other method of investigation we had not tried in this case—an interrogation of the suspect while he was influenced by anesthetic drugs! After three or four hours of questioning we had a complete confession of the crime, a description of the location of the gun, and the post-hypnotic suggestion that the suspect actually would lead us to the spot from which he threw the weapon into the pond! As promised, he helped us locate the rifle, and the case was prosecuted successfully.

More than thirty different tests under narcosis have followed this dramatic beginning. They have been concluded to our satisfaction and validated by the facts subsequently disclosed. We have no evidence of a failure in the series! Although this record is unusual, the Minnesota technique is based upon a firm historical background.

History

A study of more than 230 references to narco-analysis for criminal interrogation revealed that the evolution of our modern methods depended in every case, upon (1) the discovery of a drug which had narcotic or anesthetic properties; (2) upon the use of this drug in psychiatry where it was shown to produce changes in personality; and (3) upon the application of this combined knowledge in criminology. Recognizing this principle, those of us who were interested in improving the existing methods were obliged to continue testing newer drugs which have followed this pattern.

The process began as long ago as 1200 B. C. After the early explorations of opium, mandragora, the fumes of hemp, carbon dioxide, and potions of wine, there were few additions until after the Dark Ages. Later the Mexican Indians extracted a crude form of mescaline, called peyotl, from the cactus plant. They derived not only religious hallucinations from its use, but also used it as a means of obtaining confessions and social secrets. The priests who served these Indians reported these facts to the Old World in the 17th century. Psychiatrists of the 20th century rediscovered the modification of personality that mescaline could produce, and are now studying its effects on the accessibility of repressed information.

The Scientific Revolution of the 17th and 18th centuries discovered nitrous oxide, ether and chloroform for anesthetic

purposes. In a short time there were discussions of "anesthetic revelations" and sporadic uses of the drugs in espionage, etc. In 1903 Wagner (1) of New York used ether in the interrogation of a former police officer who was accused of murder. The technique he used in the penetration of this officer's malingering was closely similar to the very method we use today. What a shame his reports were not studied by the forensic scientists long ago!

Throughout the first half of the 20th century there was a steady and rapid increase in our knowledge of anesthetic drugs, psychiatric principles, and forensic methods. Narcoanalysis for criminal interrogation was tremendously improved by the experimental and factual results gained from the First and Second World Wars. It was during this time that House (2), discovered that scopolamine was a powerful somnifacient and amnestic drug, which he claimed would produce the truth in more than 50% of his investigations of criminal suspects. His crusade attracted great publicity—during which the newspaper reporters coined the misleading term "truth serum"—and established Dr. House as the modern father of this field of interest.

During the Wars our psychiatrists became proficient with sodium amytal and sodium pentothal in the exploration and treatment of mental illness. As we have been led to suspect, in a short time this information was brought into criminology where we find them the backbone of most pharmacological methods of interrogation. Thanks to the same teamwork and intensive effort, we also have derived plausible explanations and theories to explain the steps whereby we can elicit confessions and assay guilt or innocence during these examinations.

Lastly, the most recent advances have called for anesthesiological modification of the stages of narcosis required for proper interrogation. Perhaps the University of Minnesota is on the right path in this approach. Suffice it to say for this discussion, now various cerebral stimulants and mollifying agents have been introduced into the anesthetic mixtures. These and other changes allow the anesthesiologist to produce wide fluctuations in the level of mental alterations with greater liberty, and in conformation with the decisions of the interrogators.

Research efforts presently call for the investigation of monitoring devices, such as the polyviso and electroencephalograph. These instruments gauge and direct the planes of anesthesia. They also allow us to continue our investigations of such new agents as thorazine, lysergic acid, mescaline, etc., in combination with the basic anesthetic drugs. Of course, newer methods of administration are also under investigation.

Although I am told the finite theory of narcosis is unexplained, clinical evidence of the anesthetic stages indicates that the various segments of the brain may be selectively depressed in a known order corresponding to their evolutional age, the more recently acquired cortex being depressed first. Psychiatrists generally believe that the cortex performs the discriminatory and integrative actions of the personality, while the diencephalon expresses the primitive emotional drives. Thus, in narco-analysis for criminal interrogation we are concerned only with depression of the cortex and diencephalon, which can be achieved in the first and second stages of general anesthesia. Now, by variation in the level of depression and selective stimulation, combined with proper interrogation techniques, we can modify the personality functions and lead the suspect into known confession mechanisms.

An untold degree of the success achieved by an interrogation team depends upon their thorough knowledge of the confession mechanisms available to the conscious (and thus, the unconscious) suspect. Most of you are aware that the more frequent admissions of guilt come from the criminal's inner desire to compromise with the community. Surely, a little persuasion from friends, relatives, attorneys, and skilled officers helps. Each of these associates helps to soften the emotional conflict of the subject and reduce his fear of punishment. This mechanism is produced easily under narcosis after the perceptive and integrative personality functions are depressed.

Besides this group of delinquents who confess readily, or with little assistance, are the informers and malingerers, the psychopaths, and the addicts, who welcome narco-analysis as an excuse to divulge their knowledge without fear of reprisal by their "friends." The knowledge that narco-analysis is available for the solution of cases involving these persons has been of immense value to our local officers.

Narcosis has been used to create, facilitate, or hasten, each of the above confession mechanisms by distorting the integrative functions along several pathways. Early in depression there is a reduction of the perceptive apparatus, which also diminishes the response to emotionally unpleasant stimuli, and produces a stage of heightened anxiety, or well-being, according to the ego efforts. At this drug level, skillful questioning may evade the discrimination of the subject and obtain sufficient facts to indicate culpability. Later the drugs attack integration directly, further depress the apprehensive ego, and allow the deepest inhibitions to be released painlessly.

Because this multitude of reactions *is* possible, some evidence of guilt usually escapes even the most hardened, repetitious, offenders who feel no remorse. These men have little knowledge of the successful record of the technique, and they consent to the examination because refusal might indicate complicity, or because they believe they can avoid detection and strengthen their case in court. This challenge has been met time and time again by careful manipulation of the psychological and pharmocological levers—by rapidly fluctuating the questioning and drugs to coincide with the mood—and by patient repetition of this process over and over through all the levels of personality and anesthesia! Application of these theories has helped us develop techniques and methods which extract the maximum from our tests.

Technique

There are no "routines" that can be applied to narco-analysis for criminal interrogation, according to a standard which will insure optimum conditions every time. Each test is a problem in itself. It should be obvious also that one person cannot set himself up as an expert in *all* the phases of the test without limiting the results. Furthermore, until more research is possible in this field, the techniques we propose to discuss still must be manipulated by trial and error. The degree of precision achieved seems to depend largely upon the ability of the team members to adapt themselves, by enlargement and contraction of the knowledge applied to the problem, until they strike the proper balance in time and subject. However, certain practicalities have emerged as a result of accumulated experience. Perhaps these can be described best by

recounting the process we now follow in an ideal case—where all of our intentions can be translated into action!

When it becomes evident that narco-analysis for interrogation of a given suspect is possible, the proper team of consultants is drawn from the campus and the community. These individuals must be selected on the basis of (1) their scientific objectivity—for we do not have time under anesthesia to permit prejudice and lack of flexibility by the questioners to defeat the purpose—and (2) whatever specific contribution they can lend to the actual interrogation. For example, on different occasions we have been benefited by the presence of lawyers for defense and prosecution, judges, psychiatrists, psychologists, foreign language experts, laboratory scientists, and various investigating officers. Those who are most familiar with the personality of the suspect and the details of the crime constitute the nucleus of the interrogation team. We always select an *anesthesiologist* for the drug administration because of his obvious knowledge of the pharmacology, limitations of the various agents required, and the levels of anesthesia sought during the test. His presence and the patient-physician relationship protects the patient medically and contributes something to the patient's emotional well-being.

In the initial interview the principal interrogator attempts to establish rapport with the suspect, convince him of our impartiality and fairness, and heighten his confidence in a fair examination. We usually conduct several preliminary psychological tests to establish a more scientific basis of our knowledge of his personality, intelligence, and emotional stability. The interview concludes when the suspect definitely understands his constitutional liberties, which allow him to refuse the examination or accept the possibility that its results might be used in subsequent investigations or prosecution.

The actual narco-analysis is conducted in an operating room suite. Although it is difficult to avoid the apprehension created by this location, the safety and convenience to the patient and physician are more important. Every effort is made to alter the furniture, etc., to create a better atmosphere. A thorough physical examination and medical history are evaluated by the anesthesiologist—just as he does for routine surgical anesthesia. The suspects seem to derive additional comfort from this precaution too!

Pre-anesthetic medication with intravenous barbiturates, scopolamine, and occasionally morphine, is just as essential for these examinations as it is for surgery. The dosage of scopolamine is increased slightly, but otherwise the quantities required for routine anesthetic premedication are used. Basal narcosis is accomplished with a 2½% concentration of sodium pentothal. All of the medication is given intravenously because of the rapid onset of effect and easy control achieved. The sodium pentothal is gradually injected as we converse with the suspect about anything *but* the crime. As the first stage of anesthesia is passed and the suspect finds it more and more difficult to hear and answer our questions, the conversation is changed to more critical events. At this stage he may repeat the same story he told before anesthesia. With some persuasion, as we described in the theoretical discussion, he may begin his confession. Usually it is first necessary to traverse the whole first and second stages of anesthesia before incriminating information is released. The interrogation is varied, just as the anesthesia is deepened and lightened, according to the decisions to attempt an emotional outburst, or to confuse the orderly thinking of the suspect.

Most of our confessions have followed reactions of fear, extreme anger, boasting, love, etc. Once the admission of guilt is begun, we attempt to hold the suspect on the same train of thought, and bring him slowly out of the anesthetic until we have a clear, intelligible record of the entire confession on a tape recorder. Occasionally picrotoxin, metrazol, benzedrine, and thorazine have been used to accentuate certain of the responses. More experience will be necessary with these drugs to outline the precise role they play in the interview.

The post-anesthetic interview offers the team an excellent opportunity to confront the suspect with recordings of his guilty knowledge. When properly presented to him, this surprise often produces an admissible extrajudicial confession. Review of the tape recordings also frequently suggest new avenues for police investigation.

Not all interviews end in confessions, of course. We are quite proud to say that *most* of our suspects were innocent. Their general conduct, eagerness to assist the interrogators explain their questionable actions, and their complete free-

dom from evasion helped persuade the referring officers to look elsewhere for their criminal.

Unsuccessful results probably come from a failure to apply the principles outlined here. Undoubtedly low intelligence contributes to the difficulties encountered and wears the patience of the team. Acts committed during profound alcoholic stupor and associated with severe head wounds probably are not accessible through this means. Prolonged incarceration and violent treatment or severe questioning reduce our ease of interrogation and may, at some future date, negate our efforts.

No reports have been discovered to the effect that narco-analysis for criminal interrogation has been used to force a suspect to confess a crime he did not commit! On the other hand, guilty suspects have maintained their lies during tests by methods other than we have described here. Perhaps our statistical group is still too small, and we may soon encounter a failure. Nevertheless, until the test is more fully developed, and more accurately measured, the suspects' drug-influenced statements must be corroborated by fact before they can be admitted as evidence.

Whereas there is a great divergence of opinion about the need for legalizing these tests, we ought to conclude with a summary of our thoughts on this aspect:

(1) We have shown that the test *is* capable of application to all types of cases—adaptable to all kinds of personalities.

(2) Although the truth has been accessible in our limited experience, the suspects can still lie and thwart the examiners.

(3) It, therefore, remains with sufficient inaccuracy to advise against admission as evidence on this basis alone.

(4) The drug-induced statements must be corroborated by facts before they can serve defense or prosecution in court.

Therein lies the primary purpose of our tests. Ethically, it is far superior to third degree methods which employ physical or mental coercion. It frequently provides a rapid avenue to justice, which I am sure many can appreciate. The methods described are not intended to supplant accepted modes of investigation; rather, success seems proportioned to the quality of the investigation which precedes the narcosis! Lastly, narco-analysis is a delicate, prolonged operation, which should be available to any person who may benefit from it. But it should never be used without good reason.

I find it impossible to close without paying tribute to our anesthesiologist, Dr. James Matthews. Without his untiring efforts, knowledge and inspiration, our investigations of this technique would not have been possible. Those who are more interested in the precise details of both the drug and the interrogative process should consult the basic references outlined in the "Textbook of Legal Medicine," edited by Dr. Gradwohl, wherein Dr. Matthews has summarized our findings.

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Rapid Spectrophotometric Method for the Determination of Morphine in Urine*

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Over the past one hundred years there have been proposed a great number of procedures for the isolation and identification of morphine in biological materials. Most of these procedures fall into one of three types: (1) titration of the morphine as a basic substance; (2) reaction with the phenolic group of morphine; (3) precipitation of the morphine as an insoluble salt with an alkaloidal reagent.

Each of these procedures is relatively non-specific. Another factor which complicates morphine analyses is the fact that morphine is amphoteric which makes extraction from biological fluids extremely difficult. This paper is concerned with a study of the extraction of morphine from urine and the application of the nitroso reaction to its determination.

In 1911, Wieland and Kappelmeier (1) described the preparation of 2-nitroso morphine by reaction of morphine with nitrous acid. They described the sodium salt of this compound as a deep red material, suitable for the analysis of morphine solutions. Ochiai and Nakamura have since described this compound as 2-nitro morphine, but the true configuration is still in doubt. Whatever the structure, the compound gives a deep red color in alkaline solution. This reaction is specific for morphine and morphine-derivatives which contain a free phenolic group.

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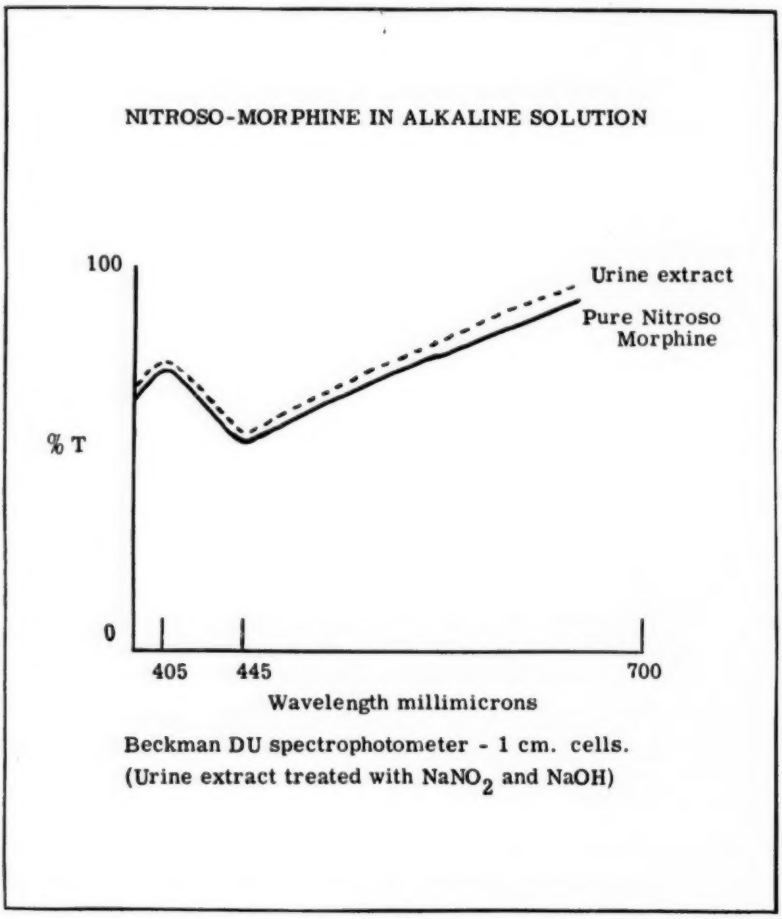
Experimental

2-nitroso morphine was prepared according to the directions of Wieland and Kappelmeier (1) and isolated as the sodium salt. The absorption curve in alkaline solution was determined in a Beckman Model DU spectrophotometer and is shown in Figure 1. The figure indicates that the compound has an absorption maximum at 445 millimicrons.

The solubility of morphine at various pH values and in various solvents was next studied. The general procedure con-

FIGURE 1



Beckman DU spectrophotometer - 1 cm. cells.
(Urine extract treated with $NaNO_2$ and NaOH)

sisted of shaking a known quantity of morphine with the solvent in question on a mechanical shaker for 15 minutes, and then isolating the extracted morphine from the solvent by shaking with 0. 1 N HCl. The morphine concentration was measured by the procedure to be described later. The results of these experiments are shown in Tables 1 and 2. The tables

TABLE 1

EFFECT OF pH ON EXTRACTION OF MORPHINE BY IMMISCIBLE SOLVENTS

(1 mg. morphine in 50 ml. volume shaken with 100 ml. solvent in a mechanical shaker for 15 minutes)

pH	Solvent	Mgs. morphine extracted	% extracted
4.2	Chloroform	0.00	0
7.0	$CHCl_3$	0.02	2
8.2	"	0.41	41
9.5	"	0.09	9
4.2	Ethyl acetate	0.00	0
7.0	" "	0.16	16
8.2	" "	0.53	53
9.5	" "	0.17	17
4.2	Iso amyl alcohol	0.00	0
7.0	" " "	0.09	9
8.2	" " "	0.69	69
9.5	" " "	0.19	19
4.2	Butanol-Benzene	0.00	0
7.0	" "	0.23	23
8.2	" "	0.97	97
9.5	" "	0.31	31

indicate that the use of a 1-1 normal butanol-benzene mixture extracts morphine almost completely from aqueous solution at a pH of 8.2. This pH is easily arrived at by adding saturated $NaHCO_3$ to the solution.

TABLE 2

EXTRACTION OF MORPHINE BY A 1-1 MIXTURE OF NORMAL BUTANOL-BENZENE

(Morphine in 50 ml. solution, saturated with $NaHCO_3$, shaken with 100 ml. solvent for 15 mins.)

Mgs. Morphine present	Mgs. Morphine extracted	Percent extracted
0.50	0.48	96
1.00	0.95	95
2.00	1.94	97
3.00	2.89	96
5.00	4.75	95

Procedure

To 50 ml. urine in a 250 ml. glass-stoppered flask is added 10 ml. of a saturated solution of $NaHCO_3$. One hundred ml. of a 1-1 mixture of n-butanol-benzene is then added and the flask is shaken for 15 minutes in a mechanical shaker. (One of the very great advantages in the use of this solvent is the fact that in over 200 urine analyses not a single emulsion was obtained.) After separation of the layers, the solvent is filtered into a graduate cylinder and the volume is measured. The solvent is then shaken with 10 ml. of 0.1 N HCl in a separatory funnel. The HCl layer is separated from the solvent and 5 ml. are pipetted into a test tube. To this is added 1 ml. of a 20% $NaNO_2$ solution, and after mixing and standing for 2 minutes followed by the addition of 2 ml. of 20% NaOH. The solution is mixed, and filtered through a small filter paper. The optical density is read in a spectrophotometer and the concentration of morphine read from a prepared graph. The calculation is completed by correcting for the volume of solvent obtained ($\times \frac{100}{\text{vol.}}$), the volume of HCl taken for analysis (x 2) and the volume of urine taken for analysis (x 2) to give morphine in mg. percent. The final figure is corrected for the normally occurring nitroso-reacting substances in urine (see Table 3).

Known quantities of morphine were added to 50 ml. samples of urine, and the procedure described above was used. Recovery of the added morphine is shown in Table 4 and indicates an average recovery of 95 percent. The absorption spectrum of the colored product obtained with extracted morphine was shown to be identical to that of nitroso morphine. The color produced under the conditions described is stable for 12 hours. The calibration curve (Figure 2) indicates adherence to the Beer-Lambert Laws over the range 0.1 to 0.7 mg. morphine in 5 ml. solution. When larger quantities of morphine are present, a smaller aliquot of urine is taken for analysis.

TABLE 3

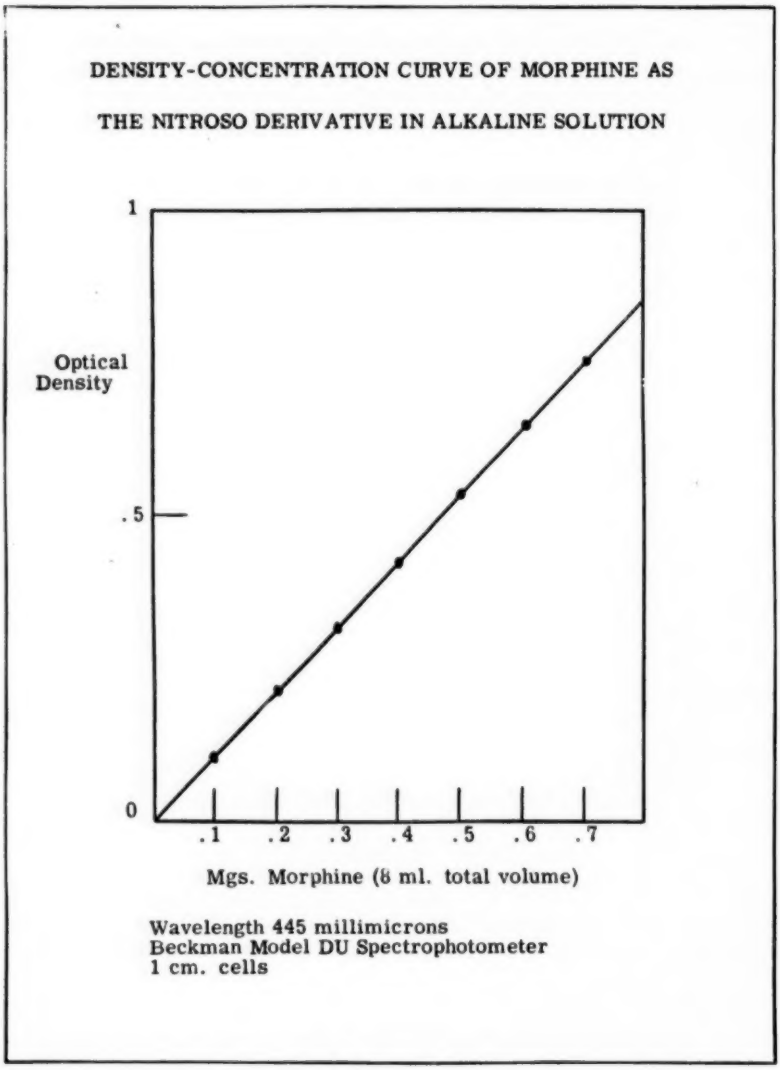
"APPARENT" MORPHINE LEVELS OF URINE KNOWN TO BE FREE FROM MORPHINE

(Nitroso Procedure)

Case #.	Free "Apparent" Morphine (mg/100 ml.)	Total "Apparent" Morphine (mg/100 ml.)
1	.17	.32
2	.19	.36
3	.17	.31
4	.21	.30
5	.13	.37
6	.21	.39
7	.19	.32
8	.22	.36
9	.17	.31
10	.19	.35
Average	.19 mg/100 ml.	.34 mg/100 ml.

A series of urines was obtained from hospital patients who had received from ¼ to 1 grain of morphine during their stay in the hospital and these were assayed as described above. The results are shown in Table 5 and indicate the presence of 0.7 to 3.0 mgs. of free morphine per 100 ml. urine. Finally a series of urines known to be free of morphine were assayed.

FIGURE 2



The results (Table 3) show the presence of "apparent" morphine normally occurring in urine to the extent of 0.19 mg. per 100 ml. urine. This figure is relatively constant and is subtracted from the final calculation as described above.

Oberst (3) (4), has shown that much of the morphine excreted in the urine is present as a conjugate, probably as the beta glucuronide. In order to determine total morphine, 50 ml. samples of urine were adjusted to pH 4.5, 5 ml. of beta glu-

TABLE 4

RECOVERY OF MORPHINE ADDED TO 50 ml. URINE

(Nitroso Method)

Amt. added (mgs.)	Amt. Recovered (mgs.)	% recovery
0.50	0.47	93
1.00	0.95	95
2.00	1.89	95
3.00	2.79	93

TABLE 5

RECOVERY OF MORPHINE FROM URINE OF PATIENTS RECEIVING MORPHINE IN HOSPITAL

(Nitroso Procedure)

Case #.	Free Morphine mg/100 ml.	Total Morphine mg/100 ml.
1	0.79	1.28
2	1.63	2.97
3	1.21	2.39
4	3.01	5.76
5	0.93	2.06

curonidase (5000 units/cc.) was added, and the solution incubated for 18 hours at 37° and then assayed for morphine as described. Table 3 shows the apparent total morphine in control urines, and Table 5 shows the total morphine content of urine from hospital patients receiving the drug. An average

value of 0.34 mg. percent "apparent morphine" is found in control urines, and is subtracted from the final calculation. Hospital patients show from 1 to 5 mg. percent total morphine in the urine. The ratio of bound morphine to free morphine varied from 1.6 to 2.2.

Demerol, methadon, codeine, heroin and a group of alkaloids including atropine, strychnine, brucine and physostigmine do not produce any colored derivative when treated with nitrite and alkali, and thus do not interfere with the procedure.

Summary

A rapid procedure for the isolation and quantitative measurement of morphine in urine is presented. Morphine is extracted from urine at pH 8.2 by a 1-1 mixture of normal butanol-benzene. The morphine is removed from the solvent with 0.1 N HCl and assayed by conversion to the alkaline nitroso salt. The color is read in a spectrophotometer at 445 millimicrons.

Total morphine is determined by treatment of the urine with beta glucuronidase. Correction values for the nitroso reacting

RESUME OF PROCEDURE

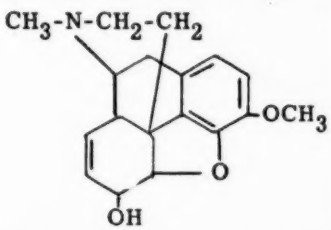
1. Aliquot of urine (50 ml. usually) plus 10 ml. saturated $NaHCO_3$.
2. Extract with 100 ml. 1–1 n Butanol-Benzene in mechanical shaker for 15 mins.
3. Solvent filtered and extracted with 10 ml. 0. 1 N HCl.
4. Add to 5 ml. of the HCl extract 1 ml. 20% $NaNO_2$. Mix and let stand 2 minutes.
5. Add 2 ml. 20% NaOH and mix.
6. Filter through a plug of cotton or small filter paper.
7. Read at 445 millimicrons against blank.

For total morphine, incubate 50 ml. urine, 5 ml. pH 4. 5 buffer and 5 ml. beta glucuronidase (5000 units per ml.) for 18 hours. Proceed as above.

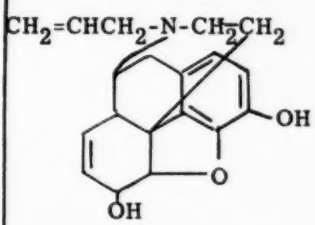
materials present in normal urines are presented. Only morphine and its derivatives containing the free phenolic group give the reaction. There is no interference from any of the common alkaloids or morphine substitutes.

Morphine

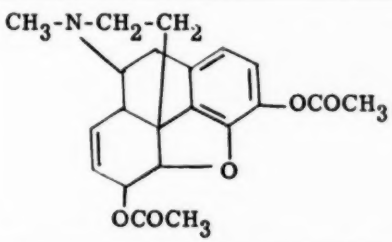
2-Nitroso Morphine



Codeine



N-Allylnormorphine



Heroin

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The Unexpected in Firearm Identification*

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In the voluminous literature upon firearm identification I have rarely noted any discussion of certain of the *un*usual problems which may confront the specialist in that field. I believe this to be due to the fact that the average practitioner of this science is a law-enforcement officer who has been assigned his task not because of any especial interest on his part in arms and ammunition, or a desire to become exceptionally familiar with these, but because the job was vacant and he was the handiest man available to fill it. As an example, I recall the former arms expert to the police department of a great city. He was a competent and conscientious police officer, but in his arms laboratory (one of his several assignments) he carried on from a sense of duty, not because he found the work particularly interesting. Naturally, he never became outstanding. Indeed, after he had been firearms examiner for his department for close to ten years he still did not realize that a gun chambered for the .38 Smith & Wesson *special* cartridge would not chamber the "regular" .38 Smith & Wesson—sometimes known as the .38 S&W "short." This is one of the most fundamental axioms of firearm identification, yet for all those years it had eluded him.

During the 1940's the same officer tossed into a nearby river, as unworthy of cluttering his office, an "ammunition board"—an item then already extremely valuable and for which collectors of today would just about pay its weight in gold. Be

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** Deceased February 22, 1955.

it explained that this device consisted of an advertising display once fancied by various manufacturers of small arms ammunition for exhibition upon the walls of stores handling their products. In addition to printed captions, each "board," housed in a huge rectangular wood frame, mounted a sample of every type of cartridge then in production by the company behind it. During the gaslight era such displays were about as common in sports shops as was the chromo of "Custer's Last Stand" in the corner saloon. Today they are scarcer than ten carat diamonds. Alas, where are the snows of yesteryear?

It is to the "whodonit" authors, rather than to the average arms "expert," that we owe, I believe, most of the publicity thus far given to the unexpected in firearm identification. For instance, I recall reading, many years ago, a fictional yarn in which a murder was committed with a caliber .30 Springfield army rifle firing a cartridge hand-loaded with a stubby, 93 grain, Luger pistol bullet in place of its much longer (and more sharply pointed) standard 150 grain projectile. Since both the Springfield and the Luger are rifled with 4 grooves, right twist, the fatal missile exhibited the proper number of grooves, slanting in the correct direction, to link it tentatively with a Luger, and search for such a weapon was instituted. After many false moves, someone had the bright idea of looking up the rifling specifications of the 7.65 mm. (.30 caliber) Luger. These revealed a rate of pitch of 9.84″, and lands and grooves almost identical in width (within .003″ to be exact). But the fired bullet, while exhibiting rifling marks of about the correct rate of pitch (that of the Springfield is 10″), gave evidence of having passed through a barrel with grooves three times as wide as the lands. Thus was the Luger ruled out, and in due course some amateur sleuth who knew his firearms, discovered that the rifling marks on the lethal missile were exactly those which would have been imparted by a .30 Springfield. From that point on, the trail was easily followed and the villain duly run to earth and made to pay the price of his deviltry!

This may sound like a pretty far-fetched plot, but such is not necessarily the case. There are thousands upon thousands of arms fanciers in these United States who own reloading equipment, and are in a position to load one or more types of

cartridge cases with a fantastic variety of bullets of different weights, shapes, and compositions; spherical, flat-nosed ("wadcutter" type), ogival-nosed, bronze pointed, hollow pointed, "spire" pointed, hollow based, flat based, full jacketed, half jacketed (i. e., "soft point"), plain lead, or lead alloy; (also, in some instances, *zinc*). To devise a load which would confuse the average "expert" would be as easy as rolling off a log. The only catch is that in any community there are no more than so many ammunition-wise sportsmen, and as soon as it has been determined that a "trick" load has been employed, a careful screening of these gentlemen should result in the eventual detection of the culprit.

However, the firing of a "trick" load from a conventional arm in an effort to create the impression that the projectile has come from a weapon of another type (as in the fictional case just related) is but one of the ways to becloud the trail. A much simpler method would be to purchase one of the "auxiliary chambers" available at nominal cost for use in many different calibers of sporting rifles. From any one of these may be fired standard pistol and revolver cartridges of the same caliber (i. e., bore diameter) as the rifle to which it is adapted but, as in the case already discussed, with bullets shorter and lighter than any factory-made for use in that weapon. Such "chambers" are made in two types, or were. The simpler variety, about to be described, I have not seen advertised since the close of World War II.

This model resembles an ordinary empty rifle cartridge case of bottleneck design, but with the head drilled out to permit the introduction and seating of a short pistol cartridge of identical caliber, and with a cylindrical case small enough to slip readily into the enlarged base portion of the dummy shell. It (the dummy) is nickel-plated. The inner walls are so dimensioned as to support and guide the pistol-type bullet when its powder charge is ignited by impact of the rifle firing-pin upon its primer. Leaving its own case, this bullet passes forward within the smooth walls of the dummy, then out of the mouth thereof and into the throat of the barrel. Obviously, the rifling marks it now acquires are those of the rifle barrel through which it passes and not of any of the various types of revolvers for use in which it has been designed. But if that barrel exhibit five or six grooves, right twist, the average

examiner will not initially realize that he is dealing with a pistol bullet fired from a rifle since many pistols and revolvers are similarly rifled (i. e., with 5 or 6 grooves, right twist). The bullet will, because of its relatively long travel *prior* to engaging the rifling, probably show rather pronounced "tippage" marks (indicative of not having entered the barrel with its long axis exactly parallel to the bore). But this should excite no surprise since such marks are common to revolver bullets. All of these pass through a smooth-bored cylinder of varying length prior to entering the rifled barrel. During this passage they tip off axis, straightening up only when bitten into by the lands of the rifling. (The more poorly made the gun, the greater the tipping. Properly designed bullets fired from rifles and automatic pistols are gripped by the rifling almost instantly upon leaving the mouths of their cases, hence show little or no "tippage," though they will exhibit "slippage" marks. These are something else again, and not pertinent to the present discussion.) If the bullet be *jacketed* (as in the .32 Colt automatic pistol type, for which many auxiliary cartridges have been designed), tippage marks may cause comment since, as just stated, bullets from automatic pistols should not display these. On the other hand, scores of thousands of foreign (solid-frame) revolvers (and a few "break-opens") have been chambered for the .32 Colt auto type cartridge (and for the .25 as well), so tippage marks on a jacketed bullet in one of these two categories might merely suggest its having been fired from such a weapon. (Strangely enough, most arms fanciers of my acquaintance are unaware that *any* revolvers have ever been bored for either of these two calibers of automatic pistol cartridges.)

The second and more complicated type of "auxiliary chamber," still actively made in several calibers, consists of a blackened steel "dummy" of the proper dimensions to fit the chamber of the rifle for which designed. Through it runs axially a firing pin which receives and transmits the impact of that of the weapon proper. At its forward end (where the shoulder of the conventional bottle-necked rifle cartridge case would normally be located) it terminates in a rim split into four equal arcs. The split cuts run backward, 90 degrees apart, down the body of the dummy well toward its head. Thus the forward end of the dummy is divided into four separate seg-

ments which stay together because they become extensions of the solid body when the cuts separating them run out. Since they are elastic, and will separate slightly when the proper force is applied, the base of a pistol cartridge of correct caliber can be twisted into the seat offered by the split rim, whereupon it will be gripped tightly by the four rim segments. (After firing, the empty case must forcibly be twisted *out* of its seat.) This design obviously permits positioning the pistol bullet almost as close to the throat of the rifling as is that of the standard rifle cartridge for which it is substituting, thus tending materially to curtail "slippage."

These devices are not the brain children of gangsters and gunmen, but of hard-headed businessmen who aim to save the shooter the cost of needlessly firing full-charge sporting cartridges (at about 20¢ per round today) when low powered pistol ammunition at but a fraction of the cost will serve as well. Such light loads are of course not suitable for use against big game, but prove eminently satisfactory for short range target work or the extermination of small animals which in some localities constitute pests. They are also effective upon man. The fact that they can confuse the arms "expert" if he lacks familiarity with them, is but incidental.

Another similar device, not now made for a considerable period but specimens of which still exist in substantial numbers, is the "R.B.S. (Rifle Bulleted Shell)." This is nothing more than a solid brass shotgun shell with a hole drilled through its long axis. This hole is now rifled and chambered to take a given pistol or rifle cartridge. I personally own specimens for cartridges as small as the .32 Smith & Wesson, and as large as the .32–40 Winchester. I have them in lengths from that of the simple shotgun shell which they replace, to that of a similar shell with a ten-inch rifled barrel extending forward from its front face. These affairs were intended for the shotgun owner who, afield for small game, furred or feathered, observed, beyond the normal range of his piece, a game or predatory animal of substantial size. By slipping a loaded "R.B.S." into the barrel of his weapon, his intended victim was at once brought within range and, with luck, bagged. Again, the fact that such a contraption can be used very handily to cover up a murder is an incidental consideration, but one of which the properly trained "expert" should be aware.

Carrying this idea further, we find yet another type—a full length rifle barrel designed to be slipped into the breach of a single or double barrelled shotgun and passed forward until its muzzle end is flush with that of the smooth shot tube in which it is centered. It is then secured by screwing about that end a threaded bushing which exactly fills the space between its outer surface and the inner wall of the shot barrel. Such "insert" barrels were once made by a prominent American firm in considerable numbers and various calibers, for shotguns of different gauges and barrel lengths. But they have now been so long off the market that specimens are rarely seen. Since they had to be positioned at the muzzle by the threaded bushing they were not nearly so convenient as the R.B.S. device. On the other hand, because of their extra length and solidity, they possessed much greater range and accuracy.

Similar types, produced overseas, have been sold in this country from time to time. Currently, the only one I see advertised is a short insert barrel for 12, 16 and 20 gauge shotguns. It is chambered for the .22 rim fire *shot* cartridge, and intended for very close range "trap" shooting at clay "birds." Such a device would hardly recommend itself to anyone with murderous designs.

There are still more jokers in the pack. These include weapons concealed in canes, belt buckles, pocketbooks, fountain pens, and the Lord knows what else. Most of these (the belt buckle variety excepted) have not been made for long periods and the use of any such for criminal purposes is a rather remote possibility.

Another anomalous setup involves the J. Reid .32 caliber combination rim fire/percussion revolver made in New York City during the 1860's. This has a readily removable cylinder with its chambers threaded at their breech ends to permit screwing into each, far enough to clear the frame when the cylinder is revolved, a typical percussion nipple. Nipples are then capped, and powder and ball inserted in the manner of the usual muzzle loader. At will, the nipples may be removed and conventional rim fire ammunition (.32 short or long) employed. The same hammer functions without adjustment in both situations. Since the piece mounts a standard bullet-seating rammer, its rim fire capabilities would never be suspected when the nipples are in place.

Similar, and simpler, are the pocket revolvers of the period of transition between muzzle- and breech-loading systems (1865–1875). These were often supplied with two readily interchangeable cylinders, one fitted with nipples for muzzle-loading, the other bored end to end for metallic ammunition. Again, the same hammer functioned equally well no matter which cylinder was employed.

Reverting to the foreign-made revolvers chambered for ammunition of .25 and .32 Colt auto. pistol calibers, a clever criminal could eject from such a weapon and leave at the crime scene, several empty cartridge cases. Since it is common knowledge that automatic pistols discard their fired cases while revolvers do not, the immediate assumption would be that a gun of the former type had figured in the affair. Such an assumption would remain valid until or unless some seasoned investigator determined from an examination of the recovered bullet or bullets that the slippage marks upon these indicated discharge from a *revolver*. In the absence of bullet evidence, he could reach the same conclusion by discovering that the empty cases showed neither ejector nor extractor marks. However, it would take a *really* seasoned investigator to figure that one out, and such men are not always available when needed.

Under other circumstances, suspicion might not fall upon a given person known to own a weapon of recognized make and well-known rifling characteristics, simply because the fatal bullet exhibited a very different rifling pattern. Yet he could be as guilty as Cain having replaced, prior to the crime, the barrel originally in his weapon with one rifled to entirely different standards. Since manufacture of the "Single Action Army" model Colt revolver ceased at the end of World War II, hundreds of worn out barrels in these weapons have been replaced with new ones not made by Colt. The original barrels show rifling consisting of six grooves, left twist. Replacements exhibit five grooves, *right* twist. In addition, a replica of this model, practically indistinguishable from it save upon close scrutiny, is now being marketed by a new maker. It is rifled with six grooves, right twist. But a likely suspect possessing either a rebarrelled Colt, or the replica, might be given a clean bill of health by an investigator who knows how a Colt is rifled but does *not* know of the numbers of these that are being rebarrelled to different rifling specifications, or that

dissimilar rifling characteristics are exhibited by the replica as well.

And finally, what of the M92 Marlin repeating rifle in .32 caliber, produced with two firing pins, one for rim fire ammunition (short and long), one for .32 short and long Colt *center* fire cartridges? Replacing one firing pin with the other is a matter of moments. Suppose we wish to "liquidate" a certain party and proceed to do this with center fire ammunition, leaving the empty cases prominently at the scene? Then we switch firing pins and when the gendarmes come to examine our weapon (which we have cleaned meanwhile) it proves to be a rim fire type. It could not possibly have discharged those center fire cases. Or could it?

This brief summary does not pretend to offer more than a few examples of the unexpected in firearms identification. Its object is to create awareness that the unexpected *can* pop up in what appears to be an open and shut case, and that unless we remain constantly on the alert to recognize it, we are likely to "come a cropper!"

The Traumatic Neuroses: Medicolegal Puzzle*

Participants: *Maier I. Tuchler, M.D.; Walter Bromberg, M.D.; Karl O. Von Hagen, M.D.; Walter Z. Baro, M.D.; Edmund D. Leonard, J.D.; Patrick J. McCarthy, LL.B.*

The Traumatic Neurosis: A Perspective

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Few syndromes in medicine present a more confused terminology than the traumatic neurosis. This confusion of labels expresses the controversial nature of the opinions regarding origin. For the past fifty years the general tendency has been to shift from organic determinants to neurotic determinants, although several of the earliest workers applied terms which suggested psychogenic mechanisms: Oppenheim (1): post-traumatic neurasthenia, and Mapother (2): post-traumatic psychaesthenia. The terms of Foerster (3): post-traumatic general head syndrome, of Trotter (4): post-concussion syndrome, and Symonds (5): minor contusion syndrome, all suggest neurogenic mechanisms.

This confusion persists to the present day. This paper will attempt to present an understanding of the various points of view expressed on this confused medical entity by an attempt to analyze the several disciplines of medicine which have contact with cases of post-traumatic neurosis and upon whom the eventual evaluation of the syndrome rests. There will be an attempt to correlate and to explain the many points of view,

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often contradictory, and relate these varied opinions to the training, the experience, and the psychological orientation of the physician who comes in contact with the problem. As these cases do involve the social and the legal institutions, the complexity of the medical opinions is compounded by the formality of the legalistic, fact finding minds of the opposing attorneys: these factors will be also subjects of analysis.

In this presentation, the general topic of neurosis in relation to trauma will be touched upon, although symptoms related to the head trauma appear to be stressed. This seems necessary for the sake of clarity. The opinions expressed concerning post traumatic neurosis involve most of the organ systems of the body: the back, for example, is a reservoir of complaint, often structural, frequently neurological, and preponderantly psychological.

Traumatic Neuroses: Definitions

Problem: The problem is to clarify the organic and the neurotic determinants in the syndrome of the post-traumatic neurosis. Briefly, on an average of six weeks to two months after a more or less severe blow to the head, and after a further hospital convalescence from the acute traumatic effects, about 80% of all such patients are recovered, while about 20% continue to complain of headaches alone or with other symptoms, which restrict or prohibit their return to social and work responsibilities.

Symptoms: Headache, with or without one or more of the following:

dizziness	visual complaints	involuntary somatic and visceral reaction
giddiness	decreased tolerance to alcohol	sweating
"blackout"	personality changes	palpitation
insomnia	intelligence changes	tremor
bad dreams		pulse abnormalities

An attempt will be made to clarify the role of the neurologist, the neurosurgeon, the psychiatrist, and to evaluate the points of view of the lawyer, both plaintiff and defense, who are so often involved in the final outcome of these problems of trauma and of compensation.

I shall purposely include the rarely marked reactions of

Malingery	present in 1% of cases
Psychotic states	present in 3% of cases
Epileptic sequelae (not so rare)	present in 20% of cases

Focal signs will also be included. *These are objective neurological signs.* What happens to these patients?

Symptoms may last for years, improvement may be slow, often extended over a period of several years. Some patients may be completely free of symptoms and function at a pretraumatic level after passage of time.

The Neurologist

As many different opinions exist on what constitutes a traumatic neurosis as there are specialists in the field of medicine. It will be our task to point out those areas of agreement as well as those areas of disagreement.

Each of the disciplines in medicine to whom the traumatic neurosis may be referred presents a particular formal background of training and study, with a complementary psychological attitude and a philosophical point of view. The training of the neurologist presents a distinctive quality. Grounded in general medicine after a background of the basic sciences, of anatomy, the neurologist in training returns to the laboratory for a comprehensive review of the basic sciences, of anatomy of the sense organs and pathology; he studies the field of neuro-anatomy, the organs of sensation and neuropathology and concommitantly hibernates for an intermediate period of time amidst the cerebral diplegias, cortical degenerations, aphasias and Parkinsonian states. His introduction to the specialty is through a demonstration of signs. He studies the disorders of the central and peripheral nervous system characteristic of the aging person, and frequently upon a degenerative basis. Throughout his training he is axon- and dendrite-conscious and the organic point of view is ever in the foreground. Altogether too often, when psychological problems present themselves in the patient suffering from a "strictly neurological disorder," he is forced to assume *that the psychological complications are part of the disorder.* In other words, the psychological implications of the diseases with which he is in contact during significant formative years

of his training, while recognized as such, are accepted as entities inclusive within the disease entities.

For this, there is a fundamental historical background. During the last half of the nineteenth century the very substantial specialty, neurology, arose, whose practitioners were forced to assume the care of many thousands of cases of "nervous exhaustion." The so-called nervous patients hitherto impatiently dealt with by physicians were treated by the practitioners of the young and growing neurology, and as the specialty grew, a growing recognition of the states of nervous exhaustion, now called neurasthenia, also increased in frequency.

Early cases of traumatic neurosis were mentioned in the Civil War experiences; the psychiatric casualties during the Civil War were impressive and puzzling, and were related to the cases of "brain weariness" and the then fashionable neurasthenia observed in cases of business stress. (Weir Mitchell (6): "Wear and Tear.") As neurology progressed, the question of general paresis and tabes were being studied in relation to syphilis, Krafft-Ebing (7) and Havelock Ellis (8) were studying the sexual pathology, and Freud brought out his views. The neurologists gradually absorbed into their practice cases of functional nervous disease. Whereas pathological studies in neurology were making rapid progress in the latter portion of the last century, therapy remained archaic. Neurology was tied to cellular changes. The development of the American school of psychiatry grew out of this neurological heritage.

The neurologist has a very distinctly organic bias toward signs and symptoms presented by a patient. Anxiety appears to be somewhat related to the degree with which a subjective symptom remains incomprehensible. When an organic point of view does not allow for an understanding of subjective symptoms, these may cause in the neurologist some anxiety. The older generation of neurologists with rather concrete conceptualizations of emotions seemed to handle this dilemma more blithely than the present generation of neurologists, who have absorbed, due to the development of dynamic psychiatry and psychoanalysis, many concepts of the dynamic structure of the personality. These latter, the younger neurologists, are therefore more recognizant of emotional factors in traumatic disease.

The Neurosurgeon

Few specialties demand more years of training than neurosurgery. On a basis of generalized surgery the neurosurgeon is trained in those neurological disorders which are amenable to surgery, is trained in specialized diagnostic procedures directed toward accuracy of diagnosis, of location of lesion and of facility of surgical intervention. He is limited frequently in the breadth and in the extent of his neurological training, particularly in the degenerative disorders, and perhaps it is just as well, for whereas the neurologist is demonstration-minded, the neurosurgeon is cure-minded. A group of neurologists discuss symptoms in relation to lesions. A group of neurosurgeons discuss the approach, the technique of surgery to a rare tumor. The neurosurgeon, being cure-minded, can reject a case freely when the neurological signs and symptoms suggest that a functional process might be involved. Rare indeed is the neurosurgeon who will operate in the absence of neurological signs. On symptoms, never. Although traumatic neurosis is recognized as a medical entity, particularly in cases of head injury, the neurosurgeon is much more free to reject such cases.

The problem of low back injury and the neurotic implications are also challenging. The low back problem presents one of the most complicated symptoms in medicine. In the presence of a ruptured intervertebral disc, where surgery is distinctly indicated, it is now common and customary procedure for the neurosurgeon to work in cooperation with an orthopedic surgeon. Yet it is not unusual to note that, in cases most adequately treated by both the neurosurgeon and the orthopedist, the residual low back complaint persists with symptoms that are tenacious and often as perplexing as those of the original symptomatology presented by the ruptured intervertebral structure. These symptoms are now of neurotic origin. These symptoms are of a type more closely explainable and understandable when studied by the psychiatrist. These symptoms have to do with an injury to the personality or ego of the patient, an injury to his conception of his body and its integrity, an injury nourished in the serious and responsible atmosphere of the hospital and the bed, an injury that can only be understood from the broadest point of view.

The Psychiatrist

The training of the psychiatrist—and now we are speaking of a training ideal—gives him a bias which is distinctive. His approach to symptoms following injury should reflect a breadth of view which includes social factors, economic factors, organic factors, as well as psychological knowledge. It is important that the psychiatrist be grounded in neurology; that he must have neurological understanding.

The psychiatrist relates his observations of the patient to a knowledge of forces of unconscious origin, whereas the neurologist relates his observations to factors in conscious life.

This brings to the fore the question of the "much-quoted authorities." Historically, the neurologist is the forerunner of the present-day psychiatrist. The age period in which an authority wrote must be reckoned. A decade may make a serious difference. World War II brought a changed concept to traumatic and psychiatric disorders.

Psychiatrists are concerned also with the relationship of the illness upon the family constellation, upon the work relations, upon marital relations.

It is clear, however, that some psychiatrists have become much too specialized; in their search for content they lose the picture of total function.

Another fallacy is noted among psychiatrists with adequate analytic training. Frequently the analyst confuses theory, which is essentially a hypothetic construct, with observable fact. This leads to a development best called parataxic. A series of symptoms may have a significant meaning to the analyst; these may or may not fit the particular constellation of the patient's symptoms in his particular frame of reference. Unless the data comes from the patient and the understanding is gained by the patient of the meaning of his symptoms, the meaning of symptoms *as outlined by the analyst* is lost to the patient.

The period of the quoted authority in psychiatry is most important. The dynamically oriented psychiatrist is a world apart from the psychiatrist attuned to the care of chronic institutional patients in a mental hospital. Each has its function. And there are extremes in psychiatric thought which, when presented in writing, offer a dilemma to the perplexed reader of what amounts to opposites in thought and ideation.

This dilemma extends from one extreme of intuitive thinking frequent with the hypothetical construct, to observable fact-finding devoid of imagination.

The Lawyer

In a paper on the "Expert Witness," presented by the writer (9), there was an insistence that psychiatry, to be useful in a courtroom and to the counsel, must be able to describe the character of the defendant. The psychiatrist must be able to understand the personality in common sense terms and furthermore must make understandable and clear, motivation. Motivation must be explainable under the influence of conscious as well as unconscious forces; it must be a dynamic psychiatry and as close an approximation that words will permit of the actual feelings, the mood and content of the patient's mentation and thought.

The lawyer wants simplification, a yes or a no. If it is possible for the psychiatrist to offer a yes or a no answer, it is his responsibility to do so. When, after thorough study and investigation, such an answer is no longer possible because the knowledge of motivation has brought to light certain facts, it is equally a responsibility of the psychiatrist to clarify the reasons by which he arrives at such opinion. The orientation of the lawyer is based upon tradition and precedent. The relationships in the courtroom are long-established, formal, and indeed ceremonial, and the law as a body rigidly adheres to what may be called a pre-scientific notion that man is a responsible being uninfluenced by environmental pressures or unconscious drives. The reasoning of the psychiatrist is an inductive reasoning and fundamentally the reasoning of the jurist is deductive. The orientation of the lawyer is based upon a concept of free will which the psychiatrist does not understand, for the psychiatrist is aware of the broad cultural, genetic and biological influences which make the traditional concept of man as an "entirely free agent" a fiction. Altogether too often the lawyer is in need of medical knowledge. What knowledge he does possess is at times adequate but limited. Present-day dynamic psychiatry has incorporated a knowledge of forces within the individual both conscious and unconscious, an awareness of motivation and a knowledge of mental mechanisms; this knowledge has reached a fairly

stable and factual basis. The law does not recognize the responsibility of any unconscious motivation except in the vaguest sense of "irresistible impulse" in a criminal case, and this only in several states in the union. What may be fact in one state, is fancy in another. The law places the whole responsibility in the conscious part of the mind. In criminal matters, the defense lawyer utilizes whatever knowledge of psychiatry he may possess and particularly what knowledge of human sympathy, empathy, feelings and emotions his pleadings may engender, and plays the theme of the unconscious to the fullest. It is not uncommon to see the spectacle of a prosecuting attorney behaving as psychiatrist, forcing the psychiatrist to defend himself, his medical and psychiatric opinions, by mobilizing his knowledge of the law and functioning as an attorney in the defense of his own professional opinion.

The use of legal thinking, which follows rules of evidence, when applied to medicine results in an obfuscation and often a downright annihilation of the problem of demonstration of subjective symptoms. It is contingent upon the psychiatrist to demonstrate that the subjective life of an individual possesses a reality. The patient must be permitted through verbalization to establish the fact that symptoms exist. If these are not brought into evidence, symptoms are but hearsay. The plaintiff lawyer in a case of emotional disturbance does follow precedent and has expert medical testimony to establish the fact that there exist symptoms which do fall into a category known as post-traumatic and which are experienced by the patient with considerable anxiety and do constitute within the definition of the term neurotic symptoms. It is through verbalization that facts are brought into evidence.

The defense attorney may take educated opinion as a theory, or a medical fact and deny its reality, implying that the patient is (what amounts to a medical truism) for purposes of gain elaborating symptoms, or he may so obfuscate the subjective aspects that the entire meaning and purpose of medical testimony is lost. One of the most effective defense attorneys in my experience never challenged the medical knowledge of the physician, nor did he in any way approach the problems of the symptoms or the alleged complaints of the patient. He simply found one slight flaw or word upon

which to hang ridicule, a haughty sneer, a jeer on the psychiatrist and upon his milieu, and I believe he was a very successful man as a defense attorney.

Both the plaintiff attorney and the defense attorney have the responsibility of taking a medical construct and fitting it into the legal thinking.

Contusion and Concussion

An Appendage to the Above: Organic Determinants

Cerebral contusion has been distinguished from cerebral concussion following a blow to the head. The word concussion is used as defined by Trotter (10) as "an essentially transient state due to head injury which is of instantaneous onset and manifests widespread symptoms of a purely paralytic kind, does not as such comprise any evidence of structural cerebral injury, and is always followed by amnesia from the actual moment of the accident." Cerebral contusion holds a fairly clearcut picture featuring minute multiple punctate hemorrhages. Larger hemorrhages brought on by cerebral laceration are not uncommon at the front and poles. The smaller punctate hemorrhages possess a perivascular distribution frequently. Degeneration which is in the cortical cells has been described and a marked diffuse glial reaction is also observed.

Experimental work on concussion has drawn attention to the fact that important mechanical differences occur in acceleration injury as compared to compression injury. Acceleration concussion has been considered an essentially direct traumatic paralysis of nerve function without vascular lesion. Acceleration concussion has been obtained on a decerebrate animal, and also on an animal under artificial respiration, suggesting that the effect of an acceleration concussion may be on the brain stem itself and was not dependent on influences of the brain on the labyrinth, nor related to respiratory failure, for on the animal in question the eighth nerves were severed, the animals were decerebrate and respiration was made under artificial measures. Threshold blows caused depression of the cardiac, the vasomotor and respiratory function for brief periods, simulating in many ways the knock-out blows of boxing.

Compression concussion requires much greater force to produce the same results than does acceleration concussion.

In compression a fracture of the skull may occur *without loss of consciousness.* Death from acceleration concussion is usually due to failure of the blood pressure. In compression of the brain the rise of cranial pressure exceeds that in acceleration concussion. It appears more and more convincing that paralytic phenomena in concussion are due to a direct paralyzing physical injury to the neuron with a loss of function, and the injury may be reversible. The rate of recovery of the neuronal damage is proportionate to the severity of the injury. Symptoms of severe concussion may persist for a considerable time after head injury. In the present state of our knowledge it is impossible to distinguish prolonged concussional symptoms from symptoms due to swelling or multiple small hemorrhages.

Early Symptoms

After a brief loss of consciousness the patient may rapidly become clearly oriented or may suffer a prolonged loss of consciousness, and the return to normality may be slow in the latter case, with the patient passing through a period of transient delirium. His traumatic delirium or traumatic stupor may last for weeks. The patient during the day is drowsy, assumes a fetal posture, resents interference, responds to disturbance with an irritability which may become violent, and is totally disoriented. At night he is incontinent and delirious, noisy and frequently hallucinating. Schilder (11) distinguishes three stages: 1. *Deep clouding of consciousness,* with general resistiveness. 2. *Clouding of consciousness,* with disorientation predominant, and 3. *After the clouding of consciousness* has subsided, a Korsakov syndrome. (Disturbances of speech functions; disorientation in space and time; difficulties in perception; inability to synthesize perceptual data; impairment of memory and function; perseverations of thought; mood changes; retrograde amnesia; post-traumatic amnesia; islands of consciousness; blood pressure, temperature, respiratory changes; spinal fluid changes; increased hyperglycemia; cranial nerve signs.)

Late Symptoms of Brain Injury

Headache, dizziness, postural relationship to dizziness, instability on changes of posture; ("the blackout"), (a combi-

nation of transitory visual impairment and instability and mental changes). Mental changes. Mild mental symptoms are a most common sequel of head injury. Some impairment of memory with an inability to concentrate are a symptom most frequent in older patients, and the symptoms most common in younger patients are a combination of irritability and nervousness. Emotional instability is also frequent. It is impossible to assess the relative importance of changes in the brain and the psychological factors in the production of these symptoms. (12) Symonds (13) says: "As to the distinction between the physiogenic and the psychogenic factors in a given case, they appear in most cases so closely intertwined that to separate them is unnatural. That a man with a hurt brain should have a hurt mind should be expected. It is equally to be expected that this disturbance will affect his capacity for adjustment as a whole. What then follows must then depend upon the psychological situation to which adjustment is called for." He further states: "It will be understood from what I have said that I hold the practice of dividing the concussional cases into two groups, labelling the one 'organic' and the other 'functional' or 'neurotic' as unprofitable and unsolid." Goldstein (14) states: "One must realize that the important question is whether the man is really suffering or not, really disturbed in his life or not, regardless of whether his symptoms have an organic cause or are psychogenic. The more understandingly we treat the man, the more shall we find him a new adjustment and the sooner will psychogenic symptoms disappear."

The period of the traumatic amnesia does seem to have some value as an index to the severity of the injury. In the absence of a focal lesion of the brain or the cranial nerve, Cairns (15), has estimated the following index of the severity of symptoms:

Period of Traumatic Amnesia	*Time*
5 minutes to 1 hour	6 weeks
1–24 hours	6–8 weeks
1–7 days	4 months
over 7 days	4–8 months

W. R. Brain (16), one of the British authorities, draws attention to the fact that the incidence of neurosis after indus-

trial injury is much higher than after motor accidents in individuals of the same social status. A wider recognition of the social responsibility for the injured is needed. The emphasis deserves a change from one of compensation to one of rehabilitation. Medical issues should be decided by medical boards linked to the rehabilitation units. An injured man is deserving of adequate maintenance as long as his medical board regards him as disabled and as long as he cooperates toward his treatment and rehabilitation.

Resumé

Normal behavior implies that an individual commands a certain skill in living. A neurosis is essentially a compromise which shows itself in mentation or thinking and in bodily incapacity or performance, caused by a preponderantly internal and intrapsychic conflict. The compromise is usually incapacitating and frequently ineffectual. It does not accomplish what it sets out to do. There is a quality of repetitiveness which has far-reaching implications in the neurosis of industry or trauma, and the degree with which the intrapsychic conflict is continuous or is stirred up by accident or injury is a factor in determining the validity of the diagnosis insofar as its relationship is concerned.

Today the discussion of any intrapsychic conflict involves recognition of the researches of Freud and utilizes the terminology of the Freudian school. This terminology and these concepts have become so much a part of American psychiatry that it is impossible to understand or to discuss neurosis without the consideration of the forces within the personality conceptualized by Freud. The preponderance and force of the unconscious drives in relation to the conscious ones is implicit in the present concept of the neuroses.

The fear of genital trauma which constitutes the core of much infantile neurosis must be regarded to a greater or lesser degree as represented by a potentially threatening force in the individual. The nature of conscience as it is formed from earliest experience in the family, in the school and in the cultural milieu, furnishes a powerful force with which human conduct is governed. The strength of the conscience over the ego and in turn over the instinctual drives has long been recognized as responsible for the symptoms of the neurotic. A good example is the somnambulism of Lady Macbeth.

Here the symptom represents an ineffectual and incapacitating solution of an overwhelming conflict of conscience. Finally, prevalent standards of propriety, essentially a social problem, a reflection of the milieu of the individual within his economic, social or cultural constellation, is important in determining the normal and those deviations from the normal with which we are at present concerned.

The traumatic experience must be likened to a precipitating factor, complicated from the outset, upon an individual within whom a balance of forces exists to such a degree that the external traumata have presented the individual with a sufficient imbalance of instinctual forces or anxiety that normal methods of control are rendered ineffectual.

Certain individuals are unable to cope with stresses in their occupational life in the absence of injury which renders their ability to integrate ineffectual. To these individuals any slight accident or injury affords a most effectual displacement behind which the inadequate defenses flourish. These individuals when sustaining an injury, frequently of mild degree, present a helplessness and hopelessness which directs the attention of the examiner to antecedent difficulties.

What does a diagnosis of traumatic neurosis consist of?

Let us consider the psychiatrist, the neurologist, or the physician himself: His theoretic orientation, his skill, his personal relationship to the patient and his bias. The organically trained neurologist of the present day has invariably prepared himself for the field of neurology from a formal matrix of internal medicine, through considerable years of study of neuropathology, the degenerative neural diseases, the organic syndromes of vascular disease, in which the problems of space-consuming lesions, the tumors, are but a small part of his field of study.

The neurosurgeon approaches the field of the traumatic neurosis from a formal and thorough grounding in neurosurgery, training in neurology and an exhaustive and precise study of those conditions which are amenable to the procedures of neurosurgery.

The psychiatrist enters the field of the traumatic neurosis, frequently grounded in basic neurology and in internal medicine, but more preponderant is his study of motivation diagnosis and therapy of the disorders of personality, with particular stress upon the unconscious factors.

Strange inconsistencies appear in the attitudes and, indeed, the biases of the professional man as he faces the alleged traumatic neurosis. The neurosurgeon frequently is extremely astute in the utilization of a clinical judgment which recognizes the presence of "hysteria" or "conversion features" in an individual. Indeed, the acumen of the neurosurgeon in whom caution in approach is developed to the highest degree in view of the deep responsibilities of his intervention, frequently upon recognition of a non-surgical condition departs the therapeutic field and delegates the patient to the psychiatrist. Occasionally the patient is relegated to the role of the malingerer.

The neurologist, with an orientation in the broad field of neurologic diseases, is frequently confronted with a more involved diagnosis.

The physician, as is altogether too common at the present time, uses the "refer the patient to a psychiatrist" diagnosis, often upon the most flimsy impression of neurosis, and the psychiatrist, sometimes not too well grounded in either of the above fields, accepts the diagnosis of another specialist—often too willingly.

It is important to call attention to the fact that each field has its particular bias and prejudice, and it is in this area that the problem of diagnosis becomes apparent. When the neurosurgeon makes a diagnosis of hysteria and refrains from surgery and speaks of conversion features, let us consider his opinion is correct. But does this impression mean more or less than that the patient is simply not a fit subject for surgery? When the patient is seen by a psychiatrist and the hysterical symptoms are confirmed, an attitude toward the individual that preserves the multiple ideology is presented. The degree with which the trauma has so disorganized the balance of the intrapsychic forces as to present a hysteric condition is the present-day approach. An evaluation of the element of unconscious gain and of guilt which the symptoms present and which undeniably marks the deeper stratum of the defenses of the ego against anxiety determine that the patient be observed and studied from a point of view decidedly different than that under which the neurosurgeon functions. Not only is the problem of the psychiatrist more time-consuming, but it demands a facility and a knowledge of the relation-

ships of the forces within the ego which is detailed, well-delineated, and follows scientific rules. The personality and the bias of the psychiatrist influence his choice of diagnostic label. One must think of diagnostic labels not as static entities, but as shifting and coalescing portions of a spectrum. It has been noted that psychiatrists have a tendency to look for a particular feature and draw inferential conclusions on the basis of such selected data—enough for an evaluation of bias.

It seems to me that the personality of the psychiatrist is an even greater factor in the facility with which he is able not only to diagnose, but of his ability to successfully treat the individual who had experienced a flare-up of a nascent neurosis in the treatment of anxiety neuroses, others with compulsion, others with hysteria. The selection of patients with whom the therapist works best and most intensively appears to be influenced either consciously or unconsciously by such factors.

Likewise, certain iatrogenic factors appear important in the emotional difficulties noted by patients. Some physicians have a very decided bias against the recognition of any factor of unconscious import in the ideology of the complaints of a patient and it can well be stated that the bias of the physician often makes him blind to the meaning of the symptoms of a patient.

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The Clinical Picture of Traumatic Neurosis

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The topic assigned to me was the clinical picture of traumatic neurosis. I would like to introduce the general proposition that the traumatic neurosis should be viewed in a social and psychological light, as well as in a clinical one. I would remind you that traumatic neurosis has been viewed with suspicion as being synonymous with malingery or hysteria in the minds of nearly everyone, including the examining physicians and sometimes the patient himself. In fact, the concept of traumatic neurosis has been a stepchild in the medical-legal field.

Now this suspicion toward the idea of traumatic neurosis goes back, I think, to the whole problem of hysteria which I would like to present very briefly in a historical perspective. You will remember that hysteria was considered a female disease exclusively until about the 1880's at which time Charcot and some others felt that men could also be hysterical. In fact, there is a story about Freud when he came back from Paris after a year of study with Charcot. In a talk before the Vienna Medical Society he said that he had seen hysteria in men and was convinced that the condition existed. His colleagues, however, thought he was swayed by French roman-

ticism and expelled him from the Medical Society for this heresy. The point is that the question of hysteria inevitably brings with it the social connotation of effeminacy or weakness in the individual who suffers neurotic symptoms. I feel that one can see glimpses of this particular social attitude toward hysteria among lay-people, juries, lawyers and even some doctors. We shall return to these so-called socio-psychological aspects of hysteria later.

The term "neurosis following trauma" is probably more accurate than "traumatic neurosis," since it emphasizes our conception that we are dealing with a disease of the ego. Now in this discussion we are talking of "constructs," i. e., theoretical concepts, for the ego is nothing that one can measure and see. Nevertheless, the idea of the ego is a valuable one and has been accepted for thousands of years in our civilization. Our task then is to discuss the impact of the trauma upon the ego.

We feel that the symptoms in traumatic neurosis are the expression of impingement of fear upon the ego which the latter is trying to master. From whence does the fear arise? It is associated with the blow suffered and its reflection upon the ego constitutes the symptoms of traumatic neurosis. Hence, the clinical picture which is multiform, is representative of the reactions of the ego in warding off, i. e., trying to master fear. The general proposition then is that neurosis following trauma arises in the ego in response to fear associated with the injury. At the same time we cannot deny that concussion, which is the direct influence of injury on the brain, modifies these symptoms. Others will discuss this aspect.

In order to pinpoint what we are saying, let me repeat the variety of traumatic neurosis symptoms encountered in about a dozen of my case reports. Reading off the complaints we find: headache, dizziness, fatigue, anxiety, tremors, sensory disturbances, weariness, insomnia, nightmares, gastric symptoms, lack of concentration, memory losses, decreased sexual libido, lack of interest, irritability, sensitivity to noises, decreased appetite, and changes in personality.

You will note that some of these are symptoms of a physical nature; that is, they are perceived as difficulty within the organs, and some of them are of a psychic nature. The former are headache, gastric symptoms, tremors, etc.; while the latter are tension, anxiety, obsessions and even sexual malfunc-

tion. Let us try to narrow down this clinical picture to the ego, which is essentially the offended organ, if I may use that expression. As close as one can come to a definition of the ego and its functions, let us say that it is the executive organ of the mind. This dynamic view means that the ego has the job of receiving impressions from the outside world, of organizing us for action, and of holding down "dangerous" emotional excitation arising from within. In traumatic neurosis, this control is deficient or weakened, so that symptoms of emotional excitation explode, to put it colloquially, into physical symptoms of anxiety, muscle tension and so on. Now what brings on this blow to the ego that results in disturbed control? (Obviously, the amount of the injury does not measure the amount of neurosis. You can have injuries of the head, the back, the arm, or the body—or no injury at all, such as a blast distant from the potential patient.) It is the threat of annihilation and destruction!

Our conception of the disturbed control of the ego is that in attempting to master the emotional agitation which has arisen from the accident, the ego repeats the experience of the accident endlessly. One may say that the ego in its frightened attempt to control the fear impinging upon it, repeats in smaller doses the stimulus of the original injuries. I had a patient who was hit while crossing the street. She remembers stepping off the curb, she remembers a flash of metal, and then she woke up some hours later in the hospital. For months she had a dream, in which there was commotion and a bright strip of monel metal appearing as an image right in front of her eyes. She wakes up in terror. That bright strip is the front of the motor car that hit her. She didn't perceive it consciously and she actually remembers nothing but stepping off the curb. But the imprint of this image, which frightened the ego was projected in the dream as an image. This is a good representation of what happens in the internal dynamics of a traumatic neurosis. The excitation spills over, and comes out, so to speak, in muscular symptoms: tremors, gastric troubles, headache, dizziness and so on.

From this follows the idea that the cure of a neurosis cannot depend upon settlement only, because basically it is a struggle between the ego and the fear it has to master. As others have pointed out, traumatic neurosis can last many months, years and sometimes for a lifetime, after a legal case

has been settled. I saw a patient just this week, a woman whose case was settled some nine months ago and of whom it had been predicted she would be entirely free of her series of symptoms after the verdict (which happened to be a substantial one). Yet she showed a continuation of the neurosis without respect to the external, legal side of it long after the settlement had been made. In other words, the essential point is that the ego's effort to control the excitation has little to do with external events, being essentially a psychological conflict.

I want to mention two more points on some of the social implications. We know that the head and spine have been given high social value in our civilization. Of all the organs of the body, the brain has great social and cultural value, and one almost instinctively wants to protect it. A man with a head injury is more apt to develop neurotic symptoms than if injury is to other parts of the body. When the ego is threatened with annihilation, which is the meaning of an accident, the head becomes over-evaluated and this is the reason that head injuries seem to be exaggerated in cases we are describing.

Another socio-psychological problem relates to the way in which the patient perceives his injuries. By this I mean that all of us when injured feel a marked instinctive hostility toward the person or object which injured us. You will recognize, I think, if you analyze the situation, that the pain following an injury is mixed with a feeling of resentment toward the one who caused the blow, be it a driver, a worker who handles equipment or an individual. This resentment spreads then from the truck driver, as an example, to the company for which he works, to the insurance company behind them and presently to all of society. In this way a neurotic attitude develops toward society itself which becomes mixed with the specific traumatic neurosis itself. Characteristically these symptoms cling for a long time, partly because of this ego problem, and partly because they (the patients) have been unjustly, to their point of view, injured and incapacitated. One sees in these cases a total change in the life direction of the patient's interest and preoccupations: the traumatic neurotic patient clings to his symptoms, hangs on to the doctor, thinks only of his case and attaches his whole life and his life direction to his accident and its consequences. This hostility has now invaded his whole ego although part of it dips into

unconscious personal problems which become engrafted upon the original symptoms due to the injury proper and constitute a complex picture which we call traumatic neurosis.

I would like to make two comments on the complicated question of malingery. In one of Keschner's cases in Brock's "Injuries of the Brain and Spinal Cord," he tells us how they picked up malingering in the old days, of a man who was presumed to be blind. The doctor put his patient's collar buttons on the bureau, and while the man was getting undressed the doctor inadvertently contrived to push the collar buttons on the floor. When the man was trying to get dressed, he reached for the collar buttons, which this blind man was not supposed to have seen dropped on the floor. This is the kind of crude test they used to give for malingering. I don't think you could use that anymore because malingery has become refined, at least I haven't seen anything so gross. What you see nowadays in malingery problems are neurotic symptoms and mental states, rather than gross paralyses or blindness or deafness. So the whole question of malingering has tended to go to what malingery means to the ego of the person. The problem of malingery can best be translated by thinking of it as "over-valued" symptoms. When we think of symptoms resulting from an ego injury which brings with it anxiety, dependence and hostility, one can no longer think of malingery as pure faking. We can say from this point of view that malingery is inextricably mixed with defense reactions of the ego: the defenses being attempts to protect the ego from the emotional effects of the injury.

I believe there is another factor to be considered, namely, that in this type of case the patient likes to involve himself unconsciously in the conflict of medical opinion. This is a function of the patient's emotional dependence. The patient unconsciously wants to befuddle the examining doctor. He adds to the clinical picture his own impression of the various doctors' examinations as the preparation of the case for legal trial continues. In this I see the patient unconsciously trying to exercise some power over the doctor, very similar to that which one sees in the child-parent relationship. Thus, all of us have seen that concern with and conflict over doctors' reports, as well as befuddlement (apparent or real) between various specialists, is the source of great satisfaction to patients. In this reaction there is unconscious hostility toward parent-

figures, then there is a secondary neurotic gain from illness (commonly called attention-gaining mechanism), then the omnipotence fantasy of being too difficult for any doctor to solve.

One can see then the complicating factors that confront one in a traumatic neurosis case. As I have tried to show, the actual concussion of the brain itself, the neurotic effects, the psychological effects and even the social reflections, as well as the legal factors all play a part in the development of this complex clinical picture.

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The Neurological Approach to Traumatic Neurosis

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The problem, as I see it, is a complex one. I don't think it's all neurological or all psychological. In some patients it's either predominantly psychological or neurological. I think that there are many variables. On one hand one must consider the severity of the injury; on the other hand there is the individual who was injured, and his way of reacting to the injury that determines his symptoms, not the degree of brain trauma. One can get along without a great deal of cerebral substance without having a so-called post-traumatic neurosis. In fact, in some patients who have post-traumatic symptoms, there is improvement with surgical removal of the injured area which has—the surgery has—deprived the patient of a great deal more tissue than the injury did.

In trying to understand this problem, it seems to me best to start with what happens to the patient when he has an injury. With the impact there is an immediate electrical discharge within the central nervous system (as has been demonstrated by Walker), which has been likened to the effect of an electro-shock treatment. Unconsciousness doesn't develop

unless this electrical discharge—this phenomenon—affects the diencephalon or the brainstem, and the duration of unconsciousness apparently depends upon the severity of this disturbance. Electroencephalographically, following this discharge there is a silent brain, in many instances. Then after a period of time this silence wears off and is replaced by high-voltage slow waves which, after a period, are replaced by a normal rhythm.

Physically there is a change in the cell structure. There is (as Courville has demonstrated) some lack of tigroid material in the cells weeks or months after a so-called concussion. If the injury is severe enough there are vascular changes, both arterial and venous, in the brain. Chemically, there is some change in the pH, and a retention of lactic acid and even disturbances in the sugar metabolism, or oxygen supply, early in the injury.

When a neurologist sees a patient who has been subjected to such an experience, it is usually weeks and months after the injury—and during this time the patient has been exposed to his own anxieties, to his relationship with his attending physician, which may be good or bad (and I have found that if the relationship is good, the symptoms are less—and if the patient feels he is neglected and pushed around, his symptoms become worse). He is also exposed to the machinations of the attorney or group of individuals who are interested in his legal welfare. He is therefore pulled and pushed between all of these conflicting interests.

On examination, the neurologist tries to find out, first, how much brain damage there was. We take a meticulous history about the episode, and find out whether the injury was one in which the head was in motion—because certainly that type of injury subjects the brain to more commotion than where the head was not in motion. Then a detailed neurological examination is done which—unfortunately—in most cases is negative. I recently saw a patient who has had his frontal and parital lobes removed by a neurosurgeon and could not find a neurological abnormality. Then the electroencephalogram is obtained, and this is usually normal—and if it's abnormal it's *still* difficult to determine what this means. If you're for the plaintiff, it means that he's had brain damage. If you're for the defendant, it means he had an abnormality before the injury. We know that about ten or fifteen per cent of the popu-

lation have an abnormal brain wave and so, possibly, this is the case. One is faced with all of these indefinables which he is asked to interpret and explain and identify, so that this patient may be correctly evaluated by those who are interested in his welfare.

The personality of the physician enters into this, and if the patient appeals to him and they develop good rapport, he is liable to be more sympathetic to the patient and, if he's a neurologist, he will say that the patient probably has had brain damage and so on. If he (the patient) antagonizes him, then he won't be quite so sympathetic and he may give a less encouraging report.

My feeling is that the majority of symptoms in these patients are a manifestation of the vasomotor instability that these patients develop physiologically after a blow to the head. These symptoms—headaches, dizziness, personality changes, the inability to remember and to think, etc. (all of which symptoms are made worse with activity or with trying to perform these functions) imply that there is some vasomotor disturbance. At first this is physiological, or a genuine disturbance of function. But because of the developing anxiety, and because of the stresses involved, this physiological disturbance is replaced by an emotional reaction which can simulate this. A patient with an anxiety neurosis can have all the symptoms of a patient with a post-concussion syndrome. He can have the vasomotor instability, he can have the headaches and dizziness, the inability to concentrate, the symptoms of neurasthenia or nervous exhaustion that were mentioned—but without ever having had a trauma. So then when you are faced with that problem, how are you going to decide? One of the difficulties with this situation is that the longer the patient has his symptoms, and the longer the case is in litigation, the more difficult it will be for him to recover. Certainly we know that of two individuals, one who is in industry and one who is in athletics, who receive the same degree of injury (and who have approximately the same personality structure), the one who is in athletics will make a complete recovery in a relatively short time, and the one who is in industry, and where his situation becomes involved in litigation, may have prolonged symptoms from which he may not recover until his case is settled. And even then, after the case is settled, he may not recover, because this thing has become

such a part of his way of behavior. Even in athletics, it has been found that injuries occurring early in the season are more inclined to have post-traumatic sequellae than those that occur later in the season, when the individual is in better shape. This, I think, indicates that tolerance for stress (especially in the vasomotor system) is greater when he's in good condition. It is a well-known fact that alcoholics are poor subjects for brain injury. An alcoholic may develop cerebral edema and die, from a relatively minor episode which another individual of the same age group (who is not an alcoholic) will survive without a great deal of difficulty. Also, the age group is important. An individual who is in his declining years (and is having a hard time getting along at his job, and is finding his job distasteful and a little unpleasant) who has a head injury, will find that this is a very practical solution to his problem and he will become incapacitated and never recover.

Lastly, the major difficulty in this problem is the fact that these patients, by and large, do not respond well to psychiatric treatment, or not until all the medico-legal factors have been settled.

I feel a little uncertain each time I see one of these patients. The physician should be objective. In fact, if all individuals involved in a situation of trauma could be completely objective so that they (we) could be intellectually honest, then the problem would be much more simple.

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Traumatic Neurosis: Medicolegal Puzzle

Walter Z. Baro, M.D., Azusa, Calif.

The term "neurosis after trauma" presents a very clean-cut picture. Many of us fail to get a proper history from the injured person. If a man or woman has been in an injury and (after getting a history from him as well as from the family) there has been a change in personality, a change in his be-

havior, in his everyday activity, and that is coupled with all the clinical symptoms discussed in the previous papers—we are then ready to make a diagnosis of traumatic neurosis or neurosis after trauma.

Just as we have varied opinions among doctors, in lawsuits we have two (at least two) different opinions, depending on whether the doctor examines for the plaintiff attorney or the defense attorney. The time has come to eliminate this problem and we should be honest with each other. If we find a neurosis after trauma, let us label it that way, and if we find malingering, let us label *it* that way.

In recent years I had an experience regarding malingering. A 36-year-old white male was hurt in September 1953, while working in a large chemical factory. He walked into a room and some fumes burned his face, his chest, his back, and his hands, and he ran out of the room with his clothes in flames, and was taken to a hospital where he received adequate care. He stayed there for six weeks and was treated by very good doctors. However, they overlooked the psychic factors. He told me that from the date of his accident he dreamed every night, during his stay at the hospital, about the explosion and the fire. Recently he told me that he sleeps very little, often not until four o'clock in the morning, that his appetite is not good at all, that he is constipated, that he has constant backaches, that he still dreams a lot about his accident, though less than before, that he's very nervous all the time, and that he trembles. In my opinion this man was suffering from a neurosis due to trauma. But now this same man has been examined by a consultant for the carrier who says as follows: "He has all the residuals of his burned area, which have very well healed," and he continues: "From these data I should conclude that as a result of the accident of September 1953, the patient sustained rather extensive first, second, and third-degree burns, from which he has made a good recovery. He has, however, developed considerable anxiety, and has modified his habits in an unhygienic way." Why doesn't the man come right out and call it a neurosis due to trauma, instead of confusing the picture by labeling it an anxiety? Here we are getting into the medico-legal puzzle; because now the attorney for the carrier can get up and say: "This is anxiety; this is not a traumatic neurosis."

Some years ago Kamman discussed a very interesting paper ("Traumatic Neurosis, Compensation Neurosis, or Attitudinal Pathosis?") and in it he takes malingering, traumatic neurosis, and compensation neurosis, and groups them all under the heading: Attitudinal Pathosis. I do not know if that is an answer.

To help in ascertaining the question of malingering, traumatic neurosis, and compensation neurosis, I place the patient in a sodium amytal interview and give him just enough sodium amytal to remove him from his conscious level into the in-between train of unconsciousness and consciousness. If the patient, as soon as I have given him the sodium amytal, tells me that he has a definite sense of well-being, I know that I am on the right track—I know that I have a neurotic to deal with. Many times I have found that a patient under sodium amytal will tell me just the opposite, that he is getting worse, or he is unable to move the leg which he was able to move before. When this happens, I am suspicious, and I search further. For example, a man who had had some acid splashed in his face, and had a diagnosis of hysterical blindness from an opthalmologist, was brought to me for study. While I was taking his history he said: "Don't ask me any questions. You have all that in those papers." This was my first inkling that I had a possible malingerer before me. This man was surveilled, and we discovered that he drove his own car to the Industrial Accident Commission for the hearing. When he appeared at the hearing, he was 'blind' again, and the attorney said: "Now wait a minute—don't you see those pictures?" He said: "What pictures?"—and they were moving pictures we had taken of the man driving his car. So malingering occurs. It is prevalent especially in a field (either the industrial accident field or in personal injury cases) where there is a question of obtaining financial gain.

If we know the patient is a malingerer, let us say it that way and not say he is "consciously or unconsciously exaggerating" —or, if the man is a neurotic, let us label it as a neurosis after trauma (or traumatic neurosis), so that the jury and the attorneys do not get confused.

We have been trying to introduce in the State of California something which has been tried successfully in the East—and that is a pre-trial consultation between the examining psychi-

atrists. So far we have been unsuccessful, and there seems little chance that we will be successful in the near future. But I feel that this might be an answer to the medico-legal puzzle of traumatic neurosis. If the psychiatrists could get together with the opposing attorneys, a lot of unnecessary fighting and name-calling would be eliminated.

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The Defense View of Traumatic Neurosis

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I represent defendants and have represented defendants exclusively for some ten years. For eight years I represented claimants, for five years I was an attorney for the State Insurance Fund. Over the years, we've obtained a lot of help from psychiatrists. They have been the end and sole answer on a great number of cases that might otherwise have been institutionalized and might be on the scrap heap insofar as humanity is concerned. So if I am critical, I am also appreciative.

I think that the description of attitudinal pathosis, which, as nearly as I can understand it from a lay standpoint, is a disinclination to work, is probably at the root of most of our troubles, from a litigation standpoint. I don't know what traumatic neurosis is. I've tried cases on it for twenty-five years. I don't think anyone else knows what traumatic neurosis is. I think that it means something different to different people. From a legal standpoint a neurosis is often the simulated disability which allows the plaintiff to enter the treasury of an insurance company, and somebody else will foot the bill.

Let me tell you that from a defense point primarily we weigh as much the people who are associated with the claimant as we do the claimant. From a practical standpoint, we have the problem of how much we're going to spend, and what we're going to do to investigate the validity of a claim. Maybe it's run three years, maybe it's run three months; maybe thirty

thousand has been spent on it medically, maybe a hundred dollars. Shall I send the man to a neurologist, a psychiatrist, an internist—or shall I simply go out and take some motion pictures and see what he's doing? It's a rough decision and a practical one, so you start out, before you make the decision, with the five "W's" of defense: Who, where, when, what, and why. As to "where" and "when," it's usually litigation and in the court, and at a specified time; and the "what" is money, and the "who" are the attorneys, the claimants and the doctors, and occasionally the judges and commissioners and referees. Therefore you look to the "why."

Now as to the "why," from the claimant's standpoint, traumatic neurosis is about the most satisfactory gadget that's ever been invented. It's extremely easy to make a prima facie case. All you have to have is a man with an M.D. behind his name and a license, to come in and testify: "The man is totally and completely disabled from a psychotic state and/or traumatic neurosis, totally unable to work, just as if his spinal cord were severed." Then you can sit back and let the defense go to work. From a defense standpoint it's hard to prove the contrary is true, and the plaintiff is pretty much liable to hit the jackpot. The odds of a jackpot *not* coming out are pretty small; it's only a question of the *size* of the jackpot. Then, it has these other advantages too. There are real, serious consequences (in the attorney's mind) from these nice cases of traumatic neurosis, or attitudinal pathosis, though it's a temporary state. It's like a man having to go for a time on crutches, except it's much better, he doesn't *have* to go on crutches. He can go to a show, he can do anything except work. So it's very convenient—non-confining, very rewarding, socially acceptable. In fact, traumatic neurosis is much more popular than appendicitis was years ago.

From the standpoint of attorneys, the name of an attorney in charge of the case may foretell the diagnosis. An attorney, say his name is Queen, has a case; and I can tell you before I ever see his patient, or go to court, what his client's symptoms will be. There are a number of these attorneys, and, say the name is Queen, we call it the "Queen Syndrome." It has everything including moist palms and an intention tremor. (You work long hours and don't sleep enough and you'll get an intention tremor. Anyone under pressure could qualify for all the objective symptoms.) The client goes along testify-

ing to the headaches, the dizziness, the vertigo, the disturbed sleep, the constipation, and what he told his wife about his impaired sexual power. Once in a while one of his clients will get on the stand and he'll forget some of these symptoms the attorney has given him in the office—so we remind him. He has them, he *remembers* he has them.

Now take your claimant, your plaintiff. For many reasons there are very few fake cases. I've seen two in twenty-six years of trial, and in one of these the man wasn't even on the job the day he was supposed to have been hurt. He was supposed to have fallen off a ladder when actually he was up in Yosemite skiing, and he fell off his skis; however, he had three witnesses, and a doctor, and everybody else. The other was a case where the doctor and the attorney went to prison for post-dating, or ante-dating, a burn case in a beauty parlor. They got the insurance as of the first of the month. It was just a little bit too bad, the accident happened ten days before, so they moved the accident back. Those are fake cases. I don't think there are many truly fake cases. But there are these considerations as we enter in our evaluation of a claimant: Many people have an inherent distaste for work, many people are primarily lazy. Walter Chrysler stated that the way he found to beat General Motors and Ford, and to shorten up processes, was to take the laziest man in a department and to set him on a new job for about ten days. And then he'd come back and take pictures of him, motion pictures. And he had eliminated every conceivable, possible effort that you could eliminate, and it beat all the costly counting and motion studies in the world. A lot of people are just that way.

Everybody loves attention, including psychiatrists. Their wives drive them down to the office and pick them up at night. (A lawyer gets his food cold, but it's warm and happy for the psychiatrist.) And a working man is just the same, or any other claimant. When a man's injured, all of a sudden he's out of a routine, he gets a lot of attention from a lot of people. His union steward is interested right now. In all the bigger motor company plants and most of the fuel company plants and almost all the factories now, there's a union steward on the job, and the bulletin board often says: Report your injury to the steward before you go to First Aid. So he goes right to the union steward. He's made a case and he's got to stick to it. It becomes a matter of moment, it's something that takes the

spotlight on him, in the union. His children have come along, and his wife is no longer interested in him. But when he gets hurt, *she's* interested. The doctor is interested, and his co-workers. Now he's got something to talk about they'll listen to; he's got an injury: "my operation."

Then he has other economic and social problems which drive him from going back to work. No matter how long he worked or how much pay he took home, he never was able to meet the bills, and he never could explain it on the grounds of his inadequate earnings. But if he can hide behind an industrial injury, then he's got a traumatic neurosis and he doesn't have to worry about this; he can let somebody else do the worrying.

Now what do we look at in a psychiatrist, what do we think about him? We know that the psychiatrist is an individual by whom we measure other individuals. He is an instrument for measurement of the norm. Now in any other field except human relationships, the thing against which we measure is a standard. Gauges are kept in moisture-proof rooms under certain temperatures so they won't change, and the gauges can be re-calibrated. It might help if we could re-calibrate a psychiatrist once in a while. But they are subject to pressures: financial pressures of their own, family pressures of their own, pressures of their associates in the office, or of the head nurse. You'll find the head nurse in a psychiatric office sometimes makes a diagnosis, and when they change head nurses you get a different picture from that office. So they get out of round; they get so they don't measure; and they get so that report after report after report fits a certain pattern, and we know it in advance. Sometimes they mirror their own ills, sometimes you have exclusive trust (the fellows that consult with other examiners).

If a person has a traumatic neurosis he shouldn't be litigating at all, because he is inflicting more psychiatric, psychological trauma, and certainly, if it's an illness, money shouldn't cure him. But that's the end for which most people shoot.

I think our emphasis should be preventive psychiatric treatment all along the line: the union agent, the employer, the family, the attending physician in particular, all these people should be educated in the things that lead to neurosis. We have it in internal medicine, we have it in all the other fields of medicine. There is a little work being done in education, particularly in Canada, and in the motion pictures. We

have nothing like that that I know of at all in industry, in common everyday walks of life. I suggest that it is very worthwhile that preventive psychiatric medicine be applied in the industrial field.

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The Plaintiff's View of the Traumatic Neurosis

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I represent the man who has been negligently injured and who is after the money, and I will give you the other side of the picture in just a few remarks if I can. I'm not going to talk about the pathological condition in which there is a neurotic overlay. I feel that my remarks will apply only too often in cases of traumatic injury where there is a definite pathological condition. But to simplify, I'm going to talk about something as concrete as possible, and I will hypothecate a classic traumatic neurosis case, namely: John Doe, a working man who pays seventy dollars a month on his automobile, has payments of seventy dollars a month on his home, has two or three children, and he earns three hundred dollars a month. Before some minor traumatic incident he was getting along, making his payments and so forth, and then a minor traumatic incident befell him and this carried into the general syndrome wherein he became diagnosed as neurotic. And this in turn led to the filing of a lawsuit, and the scene then comes to the courtroom where you have the participants in the drama: The jury, which is there to decide the facts; the judge, who is to see that the right things get in and the prejudicial things are kept from the juror's ears; and then you have the two lawyers, each serving his own function, the actors in the piece, or at least they're motivating the actors in the piece.

I would like to make some preliminary remarks before we get into the conduct of this case. I don't believe that a doctor should try to show how smart a lawyer he is, and, on the other

hand, I certainly don't think the lawyer should try to show how much medical knowledge he has, or thinks he has. If I, by some legerdemain, became a doctor tomorrow, and carried with me my knowledge and experience as a lawyer, I would feel very confident in being a medical witness because I have learned one thing: the medical witness who cannot be contradicted or confused in cross-examination is, by and large, the candid witness. He comes into the courtroom convinced that he's only there for his best opinion. He's going to give his best opinion, it's going to be an honest opinion, and when he's finished with it he will subject himself to as much cross-examination as the other side wishes to impose on him. And when some attorney says: "Now, Doctor, you've given such and such as your opinion, isn't the following so and so also true?" The doctor then candidly says: "That may be true, counselor, but you've added some factors." And by and large he conveys to the jury the impression that he's only giving his best opinion, and that's where he wants to let the whole thing lie. We have difficulty in cross-examining that doctor. The law offers you, the doctor, the position in that courtroom, of coming in and giving your opinion.

The lawyer has his job, and there is a social implication in everything he does pertaining to the case. The job of the attorney, particularly one who represents the side of the plaintiff, as I do, is lost unless what you, as the medical witness, have said makes sense in a juror's mind that he can understand. And so when we are simplifying your medical testimony by our questions at the trial, we do it because we want the jury to understand what we are talking about, especially, for example, when we hear the witness mention words like "etiology" or "semantics." I tried a case for twenty-three days before the Public Utilities Commission in California several years ago. Opposing me were the attorneys for the several railroads. As the case progressed the railroads brought in an expert from the American Railroad Association. He was elderly and distinguished looking, he was sort of an "expert of experts," and he and I boxed for two days. So we went along, both smug in our manner, we got philosophical and we went into everything. Finally I thought I asked him a sizzling question at the end of this whole series of events, and he said: "Counsel, isn't that a matter of semantics?" "Yes! Isn't it?" I replied. With this there was a

recess and everybody, including me, headed for the exits to look up the meaning of the word.

The social implications in this subject are these: The only thing that a man who has traumatic neurosis can obtain is money, the law says that. So he's going in for money, and once he has his day in court he's through in court, and all he has is his money. And the law says that that's the way a man should be rewarded, that is, by money. So I don't see anything so distasteful about talking about money. The insurance company wouldn't have this money if it hadn't taken it from somebody, and each client wants to take a little bit from the negligent defendant or his insurance carrier to recompense himself for his situation in life. Now the grave social implications here are these: Is something wrong with this man? Is he going to be able to work? Isn't it terrible to him that his family needs to meet the kind of payments that are coming due? Is it not true that all of these things which go to compose his personality and his place in life, certainly legitimately, place him in a situation where the foreknowledge that he may be unable to work is a real factor? And it is not something we should be so snide about, but rather is something we should be very frank about. Certainly a man who is unable to work has something to worry about. And I will agree that in most traumatic neurosis cases the trauma is usually slight, but there is a serious offense to the personality involved.

In putting one of these cases on for trial, I think the following things should be done: I believe that a close communion must be had between the mind of the claimant's attorney and the claimant's psychiatrist. Obviously, the jurors haven't the slightest idea of what you're talking about, unless you educate them; and to do this you must spend time with the jury, you must explain essentials, and not in big terms. What is pathology? That means there's something wrong with cells or with tissues. What is physiology? That's how things work. What is anatomy? That's their structure, how they're built, what they're made of. What is personality? A great deal of time should be spent in explaining in lay terms to a jury what is meant by human personality. It is things like this which can bring these terms home to where they're understandable to the average juror's mind. Our personalities are composed of everything in our experience, of everything in our lives. Each one is different. The Id, the ego or superego, all these things

can be explained very simply if you explain them in simple terms. Generally jurors must be made to understand that there is a difference between the enslaved subconscious, which wants things and over which the person has no control, and the conscious mind and the conscience or conflicts which developed therefrom. It can be portrayed to a jury, but it takes time, and it takes a lawyer as well as a doctor, a doctor who can at least have some understanding of the whole picture that the lawyer is attempting to bring in simple language to the jury, that the frustrations and so forth are building up in a human being till eventually the last straw breaks "the camel's back," the "balloon blows up," and the man has hysteria or some anxiety state or conversion state; and that he is in that manner saving his personality.

What is causation? Now we come to the biggest part of the problem between the life of the doctor and the lawyer. In law, if the traumatic incident is the last straw on the camel's back, and if it's that straw which broke his back and led to the traumatic neurosis, then in the language of the law that final straw *caused* the neurosis. And, yet, when you are asked on the witness stand as a medical expert, if this traumatic incident caused the neurosis, you, in good honesty, are hesitant to come forward and say that. You prefer to say: "No, I can't say that." What you want to do is to go back and say: "He had this trouble and that trouble, he has a million things. I've got to tell you all about them. This little traumatic incident alone didn't produce this neurosis that we've seen bloom since the traumatic incident. There are many things which caused it." That is where I would like to use the word "semantics." We have to go into the courtroom, and when the lawyer says: "Was this traumatic incident the cause?" *please* try to understand, if you can, that he's not asking you if it really *is* "the sole cause" in the classical sense of your medical education. He simply wants to know whether or not that was the last act, or the approximately contributing act, which occurred to bring on this neurosis. Now obviously, a man would not become neurotic from a minor traumatic incident unless he were predisposed to it. And you do not have to feel (when you are testifying for a claimant) that you must skirt around this problem. It's far better to have the matter posed this way: "This traumatic incident could not have caused this condition in this case unless we had a long history of pre-

disposing factors, a particular fragile personality, a particular time, and at this moment (of the traumatic incident) was this the contributing cause?" And your answer should be "Yes" (assuming that to be the case), because if you say "No," you have completely and totally served the position of the defendant where such position is not merited legally. For unless you come into court and make a medical case for this claimant, he (the defendant) is entitled to the presumption of innocence or non-liability. None of these traumatic neurosis cases can be won, nor can a recovery be made, unless a medical doctor testifies that in his opinion what is wrong neurotically (assuming there is something wrong) was caused by the trauma, and you are deserting worthy litigants if you will not take a bold stand when you feel that there was a cause in the sense that the traumatic incident triggered the whole predisposed personality involved in the lawsuit into the neurosis. Nobody can say in that courtroom, except a medical expert, whether it (the trauma) caused the neurosis or not. And causation is critical in these cases. In my experience I have found one kind of doctor I'm cautious with in this connection. Instead of saying: "Doctor, did the trauma cause the neurosis?" I say: "In your opinion, did you find a causal relationship between the trauma and the neurosis?" He then comes out with his background of medical thinking and says "Yes." But the judge who is sitting there thinking of legal causation, figures that the phrase "causal relationship" has some proximity to what, academically, we lawyers call "causation" and so you're speaking in two languages, but, in a sense, both minds think they're thinking the same way.

Concerning the hypothetical question to the medical expert "Does his reply involve induction or deduction?" Obviously, if you're going to induce everything you're never going to find anything wrong with the claimant where you don't have medical signs, and positive signs. And particularly is this true in neurosis, where you have nothing but subjective complaints. If an attorney puts this question to you: "Assuming the man was all right until this minor trauma; assuming that after this he has these subjective complaints you're listing, and assuming you believe him, in your opinion, could such a trauma, such an incident cause a neurosis?" And you answer: "Yes, it could possibly." If he then says: "Assuming he was all right until it happened; in your opinion *did* it cause, or

bring on a neurosis in this claimant?" You are entitled (in answering a hypothetical question) to presume as true those things which are given to you as true for the purpose of the hypothetical question. On cross-examination, if the other lawyer says: "Well now, you assumed such and such, doctor," you can very candidly reply: "Yes, I assumed those things as true in the particular question. Now if you give me some new assumptions, I'll give you a new answer."

Diabetes was once said not to occur from head injuries, and there was the defense attitude that anybody who claimed diabetes from trauma was a malingerer, and was after insurance money. We know differently now. The same is true for whiplash injuries. I have seen many whiplash cases, and from observations I knew something was wrong with those patients, but they were generally characterized as complaining, neurotic, no-good, money-seeking thieves. I've been in hospital rooms and seen women in high states of hysteria from minor whiplash incidents. Now the American Medical Association says it's a valid medical entity, so now we have legitimacy in the picture. And so with the neuroses, I say that it's legitimate today, it is a legitimate and serious condition. Where there is malingering, let that be shown, and I will agree that the malingerer's case is without merit. But, by the same token, if you, as a qualified medical expert in this field, feel there is a valid traumatic neurosis, let us be truthful and say so.

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Questioned Documents and the Law*

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During my fifteen years as a document examiner I have observed a great deal of progress among the legal profession in the general acceptance of scientific evidence in contested document cases. Much credit for this progress is due the late Albert S. Osborn, considered the dean of document examiners, and Dean John Henry Wigmore, Northwestern University Law School, for their untiring efforts which have aided in bringing about reforms of ancient practices, precedents and prejudices which tended to prevent justice in a trial court.

Under the old laws photographs were not admitted into evidence and a document specialist was not permitted to give any reasons whatever for his opininon. Not even a hand magnifying glass could be used to aid the witness or the jury. Testimony hedged about in this restrictive manner, of course, was weak and inefficient.

While the reforms of laws and procedures were evolving through progressive and scientific legal opinions of trial judges, Appellate and Superior Courts, new scientific methods were being developed in the various fields relating to questioned document problems. Reforms of laws and procedures as well as new and improved scientific methods for determining the facts in questioned document cases are constantly advancing. As a result of this progress it is now possible in most courts to effectively present the proof of the facts on the point at issue.

Some reforms of law are still needed. Although skilled document experts have demonstrated time and again that similarity in form of writing does not prove its genuineness,

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some courts still cling to an ancient rule that a lay witness who states he is familiar with the handwriting of a person may be qualified to state his opinion on the genuineness of a writing of that person in a contested document case. Sometimes all that is necessary for a witness to qualify to express an opinion is for him to state that he has seen a person write and is familiar with his handwriting. All that such witness is permitted to do is "look at" the writing and state his opinion. He is not allowed to make a comparison between the disputed writing and genuine writing.

In some courts the requirements for qualifying as a "handwriting expert" are very superficial. Merely the reading of a book on handwriting is sometimes sufficient to qualify. Courts often accept a witness as an expert simply because in his occupation or profession he has seen a lot of handwriting, such as a bank employee, school teacher or penmanship teacher. Of course, there is no reason why a person in any of these occupations or professions could not become a skilled document examiner if he studied and qualified himself, but merely reading books on handwriting does not make anyone a skilled document examiner any more than reading medical books qualifies a person to practice medicine. Certainly no one could qualify as an expert medical witness whose only qualifications were that he had read books on medicine or because of his occupation or profession he had seen a lot of sick and injured people.

More and more lawyers and judges are becoming informed of the progress that has been made in the field of questioned documents and are rapidly turning to trained document specialists to determine the facts in contested document cases. There are, however, some lawyers and judges who have no idea or only a remote knowledge of the difference between a trained document examiner and a person whose only qualifications are that he has, maybe, read a book and looked at a lot of handwriting. Three actual instances are cited to illustrate the point.

A few years ago a prominent prosecuting attorney stated to me that he had been hesitant about prosecuting cases in court when the only or principal evidence was handwriting. He explained that he formerly used a local bank teller as a handwriting expert; that on the occasion he last used this teller and while he was undergoing cross-examination, defense

counsel, to test his credibility as an expert, handed him two papers each bearing some handwriting and asked the witness to look at it and state his opinion as to whether or not both writings were executed by the same person. The bank teller looked at the writing momentarily and expressed an opinion that both were written by one and the same person, whereupon he was dismissed and followed by a person who testified he executed a portion of the writing thereby disproving the "expert's" opinion. The prosecutor stated the judge took vigorous exception to his use of obviously unqualified individuals as handwriting expert witnesses. I have testified in that court on many subsequent occasions and received quite a few complimentary remarks from the prosecutor, the judge and opposing counsel.

Sometime ago a case was submitted to the document laboratory involving numerous obscene letters sent through the mails. Most of the letters were written in pencil or pen printed characters but a few were typewritten. Specimen typing taken from a Royal portable typewriter found in the home of one of several suspects was submitted. Specimen handprinting of several persons also was furnished. The Royal portable typewriter was positively identified as the machine used to write the typewritten obscene letters. The specimen handprinted exemplars of one of the suspects, a 49-year old woman who had access to the portable typewriter, were found to be quite similar to the handprinted writing in the obscene letters. Unfortunately, however, only a very meager amount of specimen handprinted writing was obtained from this suspect and it was apparent that she had attempted to disguise.

A report was written positively identifying the Royal portable typewriter as the one used to write the typed obscene letters and stating that the evidence strongly indicated the 49-year old suspect wrote the handprinted obscene letters in question but that the evidence was not quite sufficient to support a definite conclusion and request was made for additional specimen writing. In the meantime, she employed an attorney and refused to give additional specimen writing. Prosecution was authorized and I was called to testify. Upon reaching court the prosecutor and his assistants inquired as to the reason I could not state a definite opinion concerning the handwriting. The statement that there was not a sufficient amount of known writing of the defendant to enable a thorough and

complete analysis did not satisfy them. They attempted to make an analogy by referring to the speed of an automobile. One said "See that automobile passing, don't you have an opinion as to how fast it is traveling?" The reply was that "Any opinion would be merely a guess."

Testimony was given in this case precisely as stated in the written report. The testimony was supported with enlarged photographic charts showing side by side comparison of the questioned typing and specimen typing taken from the Royal portable typewriter; also, side by side comparison of the handprinting from the obscene letters and specimen handprinting written by the defendant. The jury returned a verdict of guilty.

Recently a prominent attorney in a fairly large city in the South was consulted concerning an alleged forgery involving several thousand dollars. The attorney suggested that a handwriting opinion be obtained from a penmanship teacher in a local business college, saying that "He could look at the signature in question and tell you right away whether it was a forgery," but, said the lawyer, "He'll probably charge $25.00 for an opinion." The signature in question was a carefully executed simulated forgery and this fact could hardly be detected except by careful study and use of special instruments to detect hesitations, unnatural pen lifts and a defective line quality in the writing.

Occasionally one reads a newspaper account of some court case in which article it is stated that handwriting experts testified on both sides of the case. The facts are that in almost all such instances no qualified document examiner was on either side or only on one side. It is extremely rare that honest and experienced document examiners disagree. I have testified in approximately 300 court cases and have never been opposed by an experienced document examiner. There have been several instances where the opposing side has employed document examiners to make examinations but none has ever testified against me.

The conclusions of a trained document specialist result from sound reasoning and a proper interpretation of a comparison of visible tangible things. He does not merely look at the writing but will literally take it apart and examine every minute detail, such as speed of writing, whether the speed is

constant throughout, or varied in portions; the line quality; pressure exerted on the writing instrument; hesitations; lifting of the pen; patching; retracing; slope of writing; whether angular or rounded arches or a combination of both; position of "i" dots, "t" crossings, periods, commas and other marks; relative height of letters; whether there is evidence of tracing or simulating another person's writing, and other things too numerous to mention. He will be aided in making these examinations by special instruments, such as microscopes, micrometers, glass test plates for accurately measuring slope, angles, curves, et cetera, hand magnifiers, special photographic equipment, lens, filters and lighting equipment for making infra-red, ultra-violet and all other kinds of photographs; various chemicals and acids for testing inks and papers.

The untrained "experts" do not know how to examine handwriting and most of them have no equipment or instruments to assist them. They are also not trained to interpret and reason. Their examinations simply consist of "looking at the general appearance of the writing" and guessing, and they may be right half of the time. Scientists have reasoned that if an automobile travels between two points within a certain number of seconds its speed can be accurately determined by mathematical calculation. Special electronic equipment has been designed to calculate the speed of an automobile. Certainly scientific conclusions based upon this kind of evidence should be more accurate than that of the person who looks out of the window and gives his opinion of the speed of a passing automobile.

I have had experience in training document examiners in my official capacity and it is my considered judgment that the time required in hours of study and training to become a document examiner is equal to or exceeds that of any four-year college course. This calculates that the trainee will have the necessary educational background and basic fitness requirements before he begins to train. The training should include all phases of photography and laboratory techniques, microscopy, use of test plates and various instruments, chemical processes for testing inks, papers, et cetera. The study includes the leading textbooks on photography in all its phases, including infra-red and ultra-violet; all of the leading books on document examinations, including those on typewriters,

inks, papers, chemical formularies; books on court procedures and laws as they relate to expert testimony, court decisions; and other applicable publications; pamphlets, et cetera.

In addition to the foregoing study and laboratory work, the trainee should make examinations in at least 200 document cases and have his findings verified by a trained examiner. He should attend court on several occasions and observe testimony given by other examiners. The foregoing are minimum requirements and intend that the trainee will be employed in a document laboratory under the supervision and guidance of a trained examiner. Under these conditions and with a considerable amount of study after office hours the minimum time before going on his own as a document examiner should be three years and, preferably, four years.

After absorbing the necessary book knowledge it requires time and actual experience to be able to properly weigh, reason and evaluate. There are two necessary qualifications of a capable document examiner: (1) to be qualified to reach proper and sound conclusions, and (2) to be able to present convincing testimony in court. Both require confidence in one's self and this can only be acquired by experience, hard work and study.

From the foregoing it will be seen that a trained document specialist arrives at his conclusions by an analysis of visible factual evidence and he will refuse to let any outside influences persuade him to go beyond what he knows the evidence to be. He will be prepared to go into court and give explanations and reasons for his conclusions and will have photographic and photomicrographic charts with the contested writing and known standard writing arranged in juxtaposition for side by side comparison by the Court and Jury. Usually each juror, the Court and counsel on both sides of the case are provided with copies of the photographs.

It will be seen that the procedure followed in reaching a conclusion by a trained document examiner with his photographic presentation of evidence differs widely from the untrained person who relies entirely upon a pictorial comparison and gives oral testimony with no reasons, explanations or supporting photographic exhibits. Since opinion evidence is only as good as the supporting reasons, explanations and illustrations, it follows that the untrained person's opinion with no supporting evidence would be of questionable value.

Most questioned writing cases involve signatures; that is, whether genuine or forgeries. Hundreds of thousands of dollars are paid out yearly on checks bearing forged signatures and forged endorsements. Many cases are known where thieves have stolen letters from house and apartment mail boxes which letters were mailed by banks addressed to their depositors containing statements and cancelled checks and then draw large numbers of forged checks on the depositors' accounts, usually copying the signatures from the stolen checks. Many such forged checks are successfully negotiated at the banks upon which they are drawn and in which the depositors maintain their accounts.

Forgeries often occur on notes, wills, deeds and many other kinds of negotiable and valuable papers. Sometimes no attempt is made to disguise the writing, while in many instances the forged signatures are traced or copied. It is possible and probable that hundreds of altered and forged wills involving large estates are adjudicated in courts without the fact becoming known that the signatures on the wills and/codicils are forgeries or that fraudulent alterations have been made.

Forged signatures on wills are usually traced or simulated from genuine signatures of the purported testator or testatrix. The signature may look genuine and in fact it may be genuine and still be fraudulent. Fraudulent wills are known to have been written on blank paper which happened to bear the signature of the person against whose estate the will is drawn. A statement or other writing followed by the person's signature may have been erased or eradicated leaving only the signature, and then the spurious contents of the will handwritten or typewritten above the signature. Portions of the body of a genuine will or codicil may be changed by alterations, eradications, interlineations, insertions and substitutions of a page or pages. The trained examiner knows what to look for and very probably can detect any irregularity such as those mentioned above which would ordinarily be overlooked by a person inexperienced in making this kind of an examination.

Since it is an established fact that no person ever writes his or her signature twice EXACTLY alike, it is not possible for a forger to EXACTLY copy the signature of another person. The outline of the various letters composing the signature may be copied remarkably well and so accurately that a mere comparison of letter design will not detect any differences.

However, the forger is so intent upon copying each letter that he overlooks such inconspicuous characteristics as speed, pressure, shading, line quality, lifting of the writing instrument, hesitations, patchings, retracings, et cetera. He not only has to contend with all of these habits of his own and eliminate them, but to be successful he must do this and at the same time assume all of those habits in the writing he is copying. This is a dual process which is most difficult to accomplish so successfully that it escapes detection by a trained examiner.

A traced forgery may be expected to pictorially resemble the genuine signature in all of its general characteristics such as design of letters, height ratio, slope, lateral spacing, et cetera. If carefully executed the traced forgery can escape detection by persons unskilled in making scientific examinations of this kind. Close examination, however, will probably detect evidence of forgery. It is just as difficult, if not more so, to trace a writing and duplicate the speed, line quality, shading, pen pressure, hesitations, stops, pen lifts, et cetera, as it is to copy or simulate these features in another person's handwriting. In addition to detecting some or all of these defects, evidence of carbon, pencil or indented outlines may be discovered by examination under a microscope, or by infrared or ultra-violet photography, or by oblique light rays reflected at a sharp angle across the paper. Additional evidence of forgery that may escape detection by the untrained eye may be revealed in the formal, broken, nervous lines; the uneven flow of ink and often retouched lines and shading.

So far this paper has dealt almost exclusively with the identification of handwriting. Many other problems confront a document examiner, some of which are ink and paper analyses, eradications, alterations, obliterations, interlineations, indented writing, typewriting, printing, rubber stamps, postmarks, adhesives and mucilages, and many others. A document bearing questioned handwriting or typewriting may also bear some hidden and unsuspected evidence, which when discovered and brought to light may overwhelmingly prove its genuineness or spuriousness.

For fear it may be inferred a document examiner is capable of answering affirmatively all document problems, it is desired to state that this is not the case. A document examiner must realize his limitations and that there are some problems which defy solution. Some signatures and some handwriting lack

sufficient individuality or identifying characteristics to provide the basis for a definite conclusion. Sometimes, because of disguise it is not possible to reach any opinion.

The decision as to whether a criminal prosecution or a civil action is instituted in a court of law often hinges upon the conclusions of a document examiner. This fact imposes a serious obligation and responsibility upon the document examiner even before he appears in court to testify. It is therefore apparent that only persons of integrity and capability should be allowed to assume this responsible position.

State laws require that lawyers, doctors, dentists, and even real estate agents, barbers and beauticians pass a rigid examination under the supervision of State Boards before they are permitted to practice their professions. There is, however, no law or regulation preventing any person who desires to do so from announcing that he is a document examiner or handwriting expert and having his name and title listed in the classified section of the telephone directory. The only test for determining whether a person may testify as a handwriting expert is left to the discretion of the court after hearing the witness state his qualifications. Competent and better informed judges are turning away from the old practices and either do not permit the incompetents to testify or frown upon the use of such testimony.

Trained and conscientious document examiners both in private practice and in governmental agencies are endeavoring, not only to develop new and better scientific methods and practices, but also are striving to advance the standards and ethics of the profession through various organizations such as the American Society of Questioned Document Examiners, the American Academy of Forensic Sciences, and the International Association for Identification. The American Society of Questioned Document Examiners is composed entirely of document examiners in private practice. I am somewhat familiar with the aims and purposes of this organization. Their motto is "JUSTICE THROUGH SCIENCE" and no one is accepted for membership until his qualifications and integrity are thoroughly established.

There is probably no other single group of people outside of the legal profession who can and are doing more to aid in bringing about justice in our courts than trained document specialists. Their most ardent supporters are attorneys and

judges who have witnessed the presentation of scientific document testimony and realize its value in the administration of justice. The convincingness with which opinion testimony can be supported by photographic charts and exhibits has ended many trials abruptly. For example, in quite a few cases after handwriting testimony was given the defense attorneys have asked for short recesses and returned to the courtroom and changed their clients' pleas to guilty. Even though such testimony has resulted in the attorneys losing their cases, they realize that justice has prevailed and support and later seek document testimony when occasions arise for its use.

Examiner of Questioned Documents
Post Office Inspection Service
Questioned Document Laboratory
Cincinnati, Ohio (Retired)

Present address:
3601 Edwards Road
Cincinnati 8, Ohio

Forensic Pathology Slide Seminar*

Conducted by Arnold F. Strauss, M.D., Norfolk, Virginia

Case 1. Diagnosis: Lead Poisoning—Kidney

History: A 6-year-old white female had a three-day period of vomiting without abdominal pain two weeks before admission and again four days before admission. The day of admission to the hospital she collapsed at breakfast following a vomiting spell. She remained comatose, unresponsive and with irregular respirations. Terminally there were left-sided seizures which required sedation and anesthetics, temperature of 104°, and spinal fluid pressure of 480 mm. of water.

Case referred to Medical Examiner after review of microscopic sections and toxicology report.

Discussion: The glomeruli of the kidney contain blood. The epithelial nuclei are often pyknotic, apparently somewhat less in the juxtamedullary area where the glomeruli are more mature. The proximal convoluted tubules may have lost their brush border. Few nuclei are pyknotic. Some of the nuclei show small inclusions. (Figure 1.) In the descending narrow loop the cells vary in size and have proliferated. Here, and especially in the ascending portion, there are many nuclear inclusions. In the descending tubules one notes occasional necrotic cells and karyorrhexis and pyknosis of nuclei. Similar changes are seen in the distal convoluted tubules and some inclusions are found.

I saw pyknosis of nuclei in two similar cases with and without inclusions. In children I have never observed it, though it is seen in senile atrophy of the kidney and in diethylglycol poisoning. It may be a helpful diagnostic feature.

The inclusions, first described by Blackman (1936) (2) are characteristic and diagnostic of lead poisoning. They are

* Beginning with the present issue of Journal of Forensic Sciences, and continuing in subsequent issues, there will be published several reports of the slide seminar on forensic pathology, conducted by Dr. Strauss at the Annual Meeting of the American Academy of Forensic Sciences, February 25–27, 1954, Chicago.

most easily found deep in the cortex and in the cortical rays which contain mainly straight, thick portions of the ascending loop and the branching collecting tubules. The inclusions are sharply outlined, homogeneous, slightly more refractile than the cytoplasm, round, irregular or indented, eosinophilic or slightly purplish. Sometimes there are several of them in one nucleus. Karyosomes, the basophilic nucleoli, may be present. (Figure 2.) The nuclei are often enlarged, up to three times its normal size and finally completely filled with the inclusion. The chromatin is either on the outer surface of the inclusion or marginated at the nuclear membrane, or both. The cytoplasm may contain fat, may show signs of degeneration or, in young regenerating cells, may appear basophilic (2). The inclusions themselves are acid-fast. They are negative for neutral fat, calcium, iron, thymonucleic acid and negative for lead. Periodic Acid Schiff Stain will give a slightly positive reaction. When we stained for myelin they responded remarkably. An aldehyde group and lipids are, therefore, present. The latter may be related to acid fastness as suggested for bismuth inclusions (17). Occasionally a few inclusions can

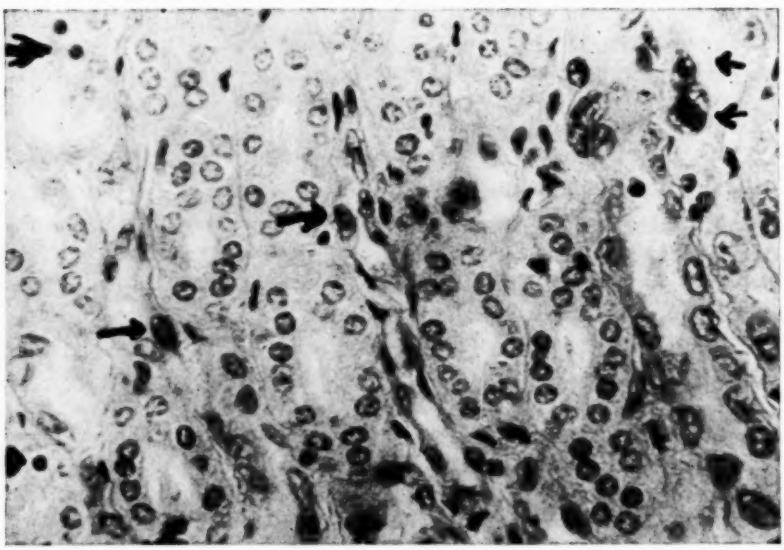

Fig. 1—Descending and ascending loop of Henle. Numerous cells with inclusions (pointers). Lining of narrow descending limb with degenerative and proliferative changes.

be found in liver cells. Rarely are they more common here than in the kidney. (2).

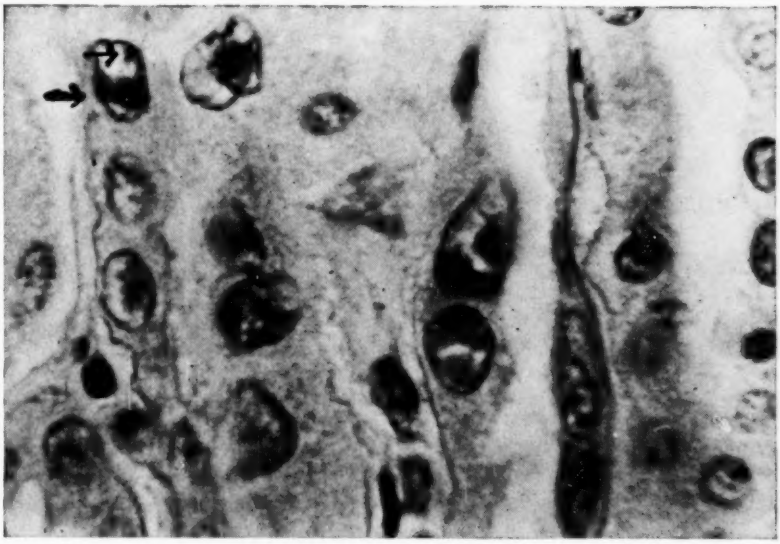

Fig. 2—Higher magnification of intra-nuclear inclusions. Inclusions large, nucleolus small (pointers).

In experimental poisoning of mice or rats none will be found before the fourth day, some within the first to third weeks and many after two months (2). In one of my own cases there were many; another showed none, though there were marked changes in the straight tubules. Neither of the cases could be dated definitely, but the second had probably a duration of less than three weeks following painting of the house with a battleship paint.

No impairment of renal function has been observed (2). Inclusions may be found without symptoms of poisoning in accidental death of lead workers (2).

The influence of the route of intake on the formation of lead inclusions has not been studied. Only ingested lead combines with fatty acid (14). Lead will penetrate into nuclei (7, 17). Why are lead inclusions acid-fast and stain for lipids? Is there any similarity to the formation of ceroid, the acid-fast pigment of cirrhotic livers, of adrenals and smooth muscle cells in nutritional disorders with impaired intestinal absorp-

tion? (13) Ceroid can be produced in vivo and vitro from lipids and erythrocytes (7). If there is any relationship, we do not know.

Since the twenties and thirties the virologists have lost interest in inclusions. Today the diagnosis of only a few infectious diseases is made through them (rabies, cytomegalic inclusion disease, inclusion pneumonia, molluscum contagiosum). On the contrary, in forensic medicine they are gaining in importance. A look at their classification, genesis and diagnostic value may be of interest.

Classification and Characteristics of Inclusions

A. *Etiologic:* (15)
   Viral
   Non viral

B. *Morphologic:*
   Intracytoplasmatic
   Intranuclear

C. *Common General Characteristics of Intranuclear Inclusions:*
   Acidophilic
   Halo
   Margination of chromatin.
   Nucleolus may be displaced.
   Stain differently from nucleolus in same cell and vary in size and number.
   Negative Feulgen (DRNA).
   Negative masked iron

D. *Classification of Intranuclear Inclusions*

1. Cowdry Type A
   (1) Amorphous or particulate, but may be condensed.
   (2) Generally acidophilic, sometimes basophilic.
   (3) Chromatin marginates.
   (4) Nucleus degenerates ultimately.
   (5) No mineral content (as present in baso-chromatin and nucleoli).
   (6) Derive most likely from oxychromatin.
   (7) Occur in yellow fever, herpes, chickenpox, salivary gland virus, pertussis, panleukopenia of cats etc.
   (8) Often viral.

2. Cowdry Type B
   (1) Hyaline droplets
   (2) Acidophilic
   (3) No margination of chromatin which is occasionally attached to inclusion.
   (4) Nucleus seldom degenerates.
   (5) Generally no inflammatory reaction.
   (6) Derive most likely from plasmosome portion of amphinucleolus.
   (7) Occur in poliomyelitis, Borna's disease, Rift Valley fever, normal in nucleus supraopticus and paraventricularis etc.
   (8) Often non viral.

Besides the acid-fast inclusions of lead which correspond in many respects to type B a number of nonviral conditions of forensic interest may produce inclusion bodies.

Bismuth (Pappenheimer and Maechling) (12, 17, 19) similarly causes acid-fast inclusions and also in renal epithelium. However, they are highly refractile, brown and do not stain with Hematoxylin-Eosin. They have a distinct membrane and are surrounded by a halo. They may perforate the nuclear wall and appear in the cytoplasm. They may be found in the urine. They are negative for bismuth. They stain for myelin.

The mercurial *Salyrgan* (11) produces type A inclusion in nerve cells.

In *salvarsan* dermatitis (8) inclusions similar to herpes (Type A) are found.

Burns (Belt) (1) will cause inclusions in hypertrophically swollen liver nuclei. They are finely granular, often in butterfly-shaped groups and due to oxychromatin segregation. They may be a sign of severe dehydration which burns have in common with yellow fever. Midzonal necroses and Councilman bodies may also be present in burns.

Experimental injection of aluminum oxide, ferric hydroxide, hypertonic solutions and repeated electric stimulation of nerve cells have produced intranuclear inclusions of B type (11).

Boric acid (Fisher) (18) produces cytoplasmatic bodies up to 10 mu in diameter in the acinar cells of the pancreas which are rounded, eosinophilic masses with deeply basophilic granules and are due to a degenerative process. They were

found in six infants who died, severely debilitated, with exfoliative dermatitis after extensive use of boric acid powder.

I have discussed inclusions rather extensively. They are forensically important. They may lead to the diagnosis in diseases and poisoning. Lead poisoning is almost certainly accidental. Lead poisoning in children is common. It should always be considered in obscure neurologic manifestations. It poses a public health problem. It is an easily avoidable cause of death. More effort is needed to warn parents of this danger.

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Case 2. Diagnosis: Contusion of Myocardium 27 Hours After Cardiac Massage (Injury—58 Days Prior to Death)

History: A 66-year-old colored male who was in an auto accident received an intertrochanteric fracture of the left hip and a posterior dislocation of the right hip. Because of persistent sciatic nerve pain, he was operated on for exploration of the sciatic nerve. While on the operating table he had a cardiac arrest and was treated by intra-thoracic massage for 20 minutes before heart beat was restored. He never regained consciousness and the blood pressure remained low until he expired.

Case referred to Medical Examiner because decedent had been injured in an auto accident.

The age of the lesion became important from a forensic point of view.

Discussion: One of the microscopic sections gives an overall impression of massive hemorrhage of the epicardium and myocardium. Erythrocytes are scattered throughout the areas of the section, most marked close to the epicardial surface. Here the fibers are thinned out. (Figure 1.) Often the cross-striation is lacking, often over-distinct. Harman (2) has described swollen, anisotropic dark disks, 2 to 4 hours after ischemia, in skeletal muscle of rabbits. They may be worthwhile watching for in very early cardiac lesions. Occasional fibers show swelling and fragmentation. In many areas there are emigrated neutrophils about the vessels. They are well preserved compared with a slide of a 5 day old lesion. A rare fiber shows an emigrated neutrophil. Some of the veins have thrombi.

The erythrocytes are broken up into smaller round fragments, so-called schizocytes. (Figure 2.) These fragmented cells are interesting because they show, in tissue sections, the

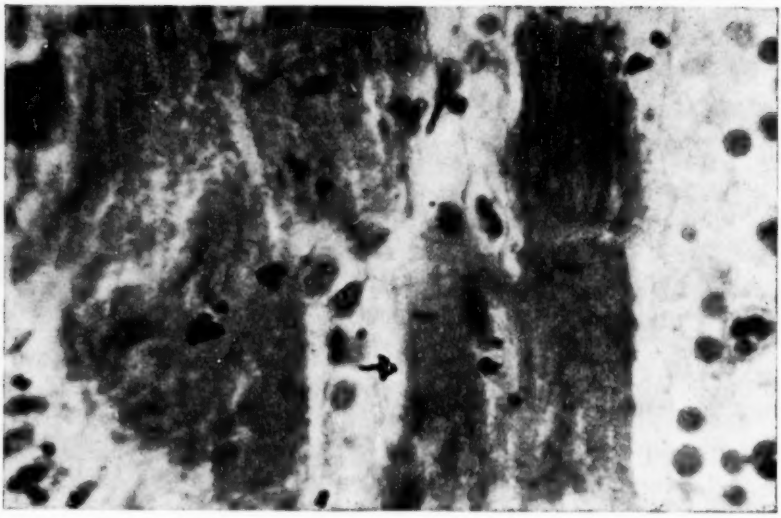

Fig. 1—Myocardium. Indistinct and over-distinct cross-striation (pointer).

localization of erythrocyte destruction (5). I suspect that the coronary circulation is a site where erythrocytes are beaten down to invisible particles. You can easily observe this process within the sinusoids of the myocardium in almost any strong, hypertrophic heart. Schizocytes are found in peripheral blood early after burns. There they are caused by the effect of heat on the vessels of the skin (1, 6).

Is the cardiac lesion an infarct or a contusion due to massage? The cardiac infarct is not of the hemorrhagic variety, but it also does not show a clear cut anemic picture as we see in naturally immobilized, non-beating organs, such as spleen and kidney.

The lesion we see is far more diffuse and disorderly in regard to hemorrhage and neutrophilic infiltration than the usual infarct. There seems to be a certain lack of monotony in the early degenerative changes of the muscle fibers. This and other features previously mentioned confirm rather a contusion due to cardiac massage than a lesion due to vascular occlusion.

The second approach to an analysis of the lesion is timing. The patient died 27 hours after cardiac arrest and massage. Does the lesion conform to this age?

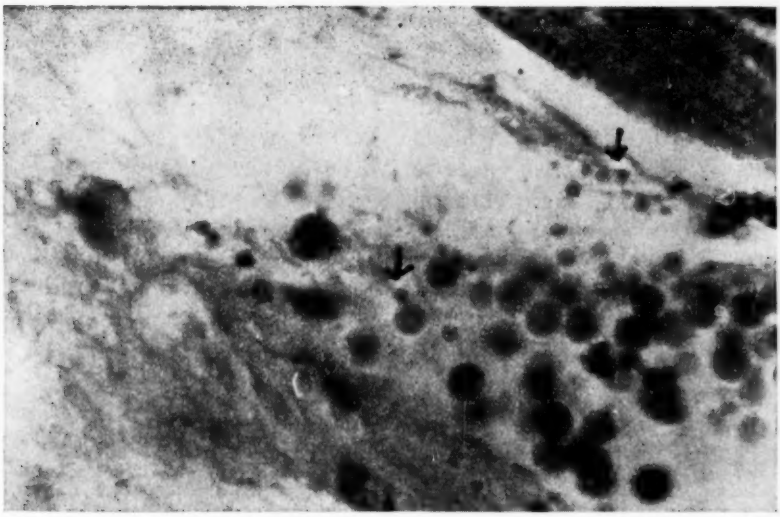

Fig. 2—Vessel with numerous schizocytes (pointer).

Karsner and Dwyer (3) have studied infarct age in dogs, and Mallory, White and Salcedo-Salgar (4) in men. In the tables I have listed characteristics helpful in timing mentioned by these authors. The dog has a small heart and, therefore, a smaller infarct than man and the heart of the experimental animal is healthy. It, therefore, gives an impression of possible minimal time for changes to occur.

If we use the table as a yardstick for our lesion, we find all features present at 24 hours. There is, perhaps, a slightly greater irregularity of the leukocytes with a rare one migrated into a fiber, possibly because some muscle fibers were mechanically damaged by the massage. There is no proliferation of fibroblasts and capillaries as seen on the fourth day. The microscopic examination confirms the interpretation that the lesion is of 27 hours duration. The car accident took place 58 days prior to death and no connection with it exists.

Legally, the development of cardiac lesions following injury poses important questions which we cannot here discuss fully. Spontaneous cardiac infarct must be distinguished from lesions due to trauma. Morphologic characteristics and especially timing can solve the problem. Timing is

of far greater importance in legal than in non-forensic pathology. It requires knowledge and experience. We have started a collection of timed lesions at the Office of the Chief Medical Examiner of Virginia, which we hope may one day become a Registry of Timed Lesions. It would assure a reference library of great value to the pathologist. There he may look up morphologic changes of lesions of well determined age in the young and old, in the healthy and sick. Another project which seems important to me would be the collection of data on timing and age of lesions now scattered throughout countless publications whose titles give no clue to the valuable information they contain.

ESTIMATION OF AGE OF INFARCT
GROSS

TIME	APPEARANCE
0	Purplish discoloration (dog).
½ hour	Pallor (dog).
12 hours	Pale, dry cut surface (dog).
1 day	Cut surface bulging, slight central collapse (dog).
2 days	Dry with sometimes red purple areas of hemorrhage.
3 days	Fine peripheral yellow zone of demarcation by neutrophils.
6–8 days	Broad yellow occasional greenish hue of demarcation.
8–10 days	Greyish red line at periphery. (granulation tissue) 10th day 1 mm. wide.
2 weeks	Peripheral greyish red zone 3–4 mm. Central depression (removal of necrotic material).
3–4 weeks	Greyish red with islands of necrotic muscle tissue.
2–3 months	Fibrous scar.

HEART
MICROSCOPIC ESTIMATION OF AGE OF MYOCARDIAL INFARCTS

Cells and Tissue	Dog	Man
Congestion and edema	½h. 12h still conspicuous.	
Hemorrhage	½h small, spotty, 12h marked.	Small, focal, rather rare between muscle fibers.
Fibrin	12h to 18 days.	24h pericarditis, 9th day organization, which may last up to 1 year.
Muscle fibers cross striation	½h loss, not demonstrable with PTH 12h loss	5 to 6h large irregular cross bands.
Hyaline	12h, marked in 24h.	5 to 6h, necrosis first 24h.
Fragmentation	12 to 24h, 14 days still marked.	
Nuclei pyknotic unstained proliferated fatty change	12h 24h 3 days 24h	Previously normal heart with sudden occlusion only in periphery of infaret.
Neutrophils	12h emigrated at vessels	2 to 4 days increasing, 48h slight degeneration, 4th day necrosis, 5th day nuclear debris, 14th day completely disappeared.
Eosinophils		4th to 18th day.
Plasma cells and lymphocytes	3rd to 6th day distinct plasma cells, 10 days still present.	6th day plasma cells, 2 to 4 wks. many, 3rd wk. lymphs + plasma cells prominent.
Pigmented macrophages		4th day, persisting 1 to 2 years.
Hemolyzed erythrocytes	6 to 11 days.	6 to 11 days.
Fibroblasts and blood vessels	24h mitoses, 48h many mitoses, 6th day zone of demarcation, 7th day in muscle fibers, 12th day condensed nuclei.	4th to 5th day proliferations, beginning at endocardial side.
Collagen		12th day first fibers, 3rd wk. distinct.
Removal of necrotic tissue	12h beginning, 11 to 18 days continuing decrease with increase of fibrous tissue. 18th day normal muscle fibers end abruptly at scar.	4th to 5th day first signs, 7th day distinct, 10th day 1 mm. at periphery cleared. 15th day 3 to 4 mm. cleared, 4 mos. necrotic tissue may still be present.

Note: h = hours

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Case 3. Diagnosis: Hemangioendothelioma

History: A 67-year-old negro male was admitted to the penitentiary hospital on June 3, 1953 because of two episodes of hematemesis in one day followed by passage of tarry stools. Repeated transfusions failed to return the hemoglobin to normal level and he continued to have occasional episodes of hematemesis. Gastro-intestinal x-rays were interpreted as varices of esophagus with an irregular filling defect at the cardia. He progressed fairly well, but a few days before his death he complained of "throbbing in his head." Blood Pressure 140/86. On June 23, 1953 he suddenly lost consciousness, became pale and clammy, and vomited. Blood Pressure 186/110. He remained unconscious and expired four hours later. At autopsy the liver weighed 3,300 gm. and contained numerous dark red tumor nodules. There was a large left cerebellar hemorrhage and a hemorrhage in the right occipital lobe. The brain also contained numerous discrete, dark red tumor nodules, as did the lungs. Small solitary, similar tumors were found in the ileum and gallbladder.

The Virginia statute requires all deaths occurring in prison to be investigated by the Medical Examiner.

Discussion: Microscopic sections of the liver reveal indistinct circumscribed areas of a growth with much necrosis and hemorrhage. The periphery is interspersed with remnants of liver cells and bile ducts appearing somewhat like giant cells under low power. A most characteristic area of the tumor shows anastomosing channels often closely lined with rather small cells, varying in size and shape, of fusiform, rounded or

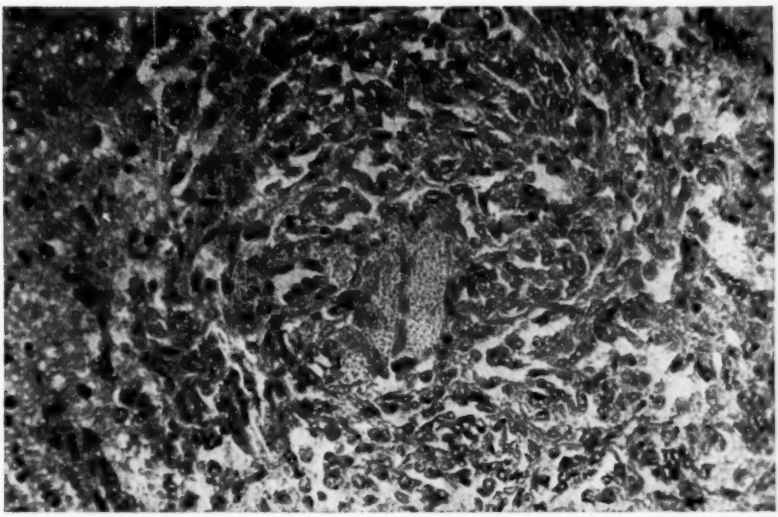

Fig. 1—Anastomosing blood channels lined with fusiform endothelial cells.

polygonal appearance. The impression is that of branching, intertwined vessels, too closely lined with endothelial elements which on occasion grow outwardly. A silver impregnation brings into view, in many areas, fine fibers surrounding each channel.

I do not think that this tumor could be confused with other markedly hemorrhage types of growths, such as chorioepithelioma, embryonal carcinoma or neuroblastoma. Carcinoma of the thyroid or kidney, which can be highly anaplastic, were ruled out by gross and microscopic study of these organs. The branching channels, with endothelial-like elements surrounded by argentophil fibers, are characteristic for hemangioendothelioma. Primary liver tumors tend to have the large, wild cells of hepatomas or the adenocarcinomatous appearance of cholangioma. One, who with Willis (9), doubts the existence of malignant blood vessel tumors, may be inclined to think of a highly anaplastic variety of bile duct carcinoma.

Two names are in use for malignant blood vessel tumors, hemangioendothelioma and angiosarcoma. The latter is more commonly applied for the Kaposi and post-mastectomy types. They tend to show proliferating, granulation tissue-like capil-

lary vessels, an inflammatory component, and fibrosarcoma-like areas; though fields indistinguishable from hemangioendothelioma may be present.

The forensic pathologist needs a wide range of knowledge and ought to be a good diagnostician to work up his cases properly, if only to contribute to more accurate death statistics.

Tumors are apt to become legal problems when occupational or post-traumatic. Hemangioendothelioma occurs after alleged injury as any other tumor. The incidence is rather low. Stout (7) reports two in eighteen cases. McCarthy and Pack (4) mention that three of their twenty cases had traumas "verified by medical records."

The tumor occurred after irradiation in three of Stout's cases. Radium and X-ray are cancerigenic agents. I personally believe that irradiation of benign lesions should be avoided when possible. The coincidence of cancer and previous radium and X-ray treatment has impressed me. To quote only one experience: In our six cases of the relatively rare malignant mixed mesodermal tumor of the uterus two had received radium, five and six years earlier (8).

Of doubtless traumatic origin is the lymphangiosarcoma arising 6 to 24 years after mastectomy in lymphedematous arms. Since 1948, when first described by Stewart and Treves (6), fourteen cases have been reported (3). Aegerter and Peale (1), as well as Hausson (2) described similar lesions in legs, 29 years after infection with consecutive lymphedema. Rawson and Frank (5) reported lymphangiosarcoma in post-mastectomy lymphedema occurring 14 years after operation. Occupational edema in persons who have to stand on their legs for a long period of time predisposes to Kaposi tumors according to McCarthy and Pack (4).

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